CHAPTER 2: ALTERNATIVES

2.1 REGULATORY SETTING FOR ALTERNATIVES ANALYSIS

The Council on Environmental Quality's (CEQ) regulations describe the alternatives section as the "*heart of an Environmental Impact Statement (EIS)*" and require exploration and evaluation of all reasonable alternatives (40 Code of Federal Regulations [CFR] 1502.14). CEQ further defines reasonable alternatives as "*those that are practical or feasible from the technical and economic standpoint and using common sense*" (CEQ 1981). National Environmental Policy Act (NEPA) implementation procedures for the United States Army Corps of Engineers (the Corps) describe reasonable alternatives as those that are feasible, and then further specify that such feasibility must focus on the accomplishment of the underlying Purpose and Need (33 CFR Part 325, Appendix B).

The Corps will follow the Clean Water Act (CWA) Section 404(b)(1) Guidelines (40 CFR Part 230) when evaluating the permit application from Donlin Gold, LLC (Donlin Gold). The 404(b)(1) Guidelines require examination of practicable alternatives to the proposed discharge (or action) and other factual determinations. An alternative is considered practicable "*if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes*" (40 CFR 230.10). The Guidelines require that the least environmentally damaging practicable alternative (LEDPA) be determined for permit consideration.

Both the CEQ and the Corps NEPA implementation procedures require consideration of a No Action Alternative; for a Corps EIS this alternative would preclude any construction that would require a Corps permit (33 CFR Part 325, Appendix B). The No Action Alternative (Alternative 1) is described in Section 2.3.1. Donlin Gold's proposed mine development project is Alternative 2 and is described in Section 2.3.2.

Over 300 alternative options were developed and screened to satisfy NEPA requirements; satisfy the Corps Public Interest Review (33 CFR 320.4(a)); assure compliance with the requirements of the 404(b)(1) Guidelines; and to enable Federal, State, and cooperating entities the ability to make permitting decisions if and where necessary. These options were systematically examined to determine the reasonable alternatives to include in the Draft EIS. Alternatives carried forward for detailed study are presented in Sections 2.3.1 through 2.3.7.

CEQ regulations also require a brief discussion of the reasons for eliminating alternatives that were considered but not carried forward for detailed study. Alternatives that were considered but eliminated are presented in Section 2.4.

2.2 ALTERNATIVES DEVELOPMENT PROCESS

In addition to the No Action and the Proposed Action alternatives, the EIS Team conducted several workshops with the Cooperating Agencies, and developed a range of alternatives for analysis using a five-step process that began with issues raised during scoping (see Section 1.7).

It is important to understand the terms "component," "subcomponent," "option," and "alternative" when reviewing this chapter:

- Component – a complete mine has several components, each necessary to allow production. For the Donlin Gold Project, there are three primary components: mine site, transportation facilities, and natural gas pipeline.
- Subcomponent – each primary component includes subcomponents; for example, the open pit and processing plant are subcomponents of the mine site.
- Option – for each component / subcomponent there are one or more options.
- Alternative – an alternative is a complete package of options that comprise a functioning mine project.

In the overall Alternatives Development Process described below, consideration was given to the project's large geographic footprint; the three different, but connected, primary components (mine site, transportation facilities, and natural gas pipeline), and comments provided by the public, stakeholders, and agencies in scoping.

Alternatives Development Process

Step 1: *Identify Scoping Issues and Related Project Components*

Step 2: *Develop Screening Criteria*

Step 3: *Identify Options to Address Concerns for Each Component & Subcomponent*

Step 4: *Apply Screening Criteria to All Options; Develop Options to Carry Forward and Carefully Document Option Disposition*

Step 5: *Package Options into Action Alternatives*

Step 1 of the alternatives development process was to identify the issues raised in scoping and then to relate them to the project components and subcomponents.

Step 2 was to develop the criteria for future screening of each option. To narrow the range of options considered, criteria were organized around three screening tests: purpose and need, feasibility (including logistics), and environmental impacts. The screening criteria are more fully described in Section 2.2.1.1.

In Step 3, options were identified to address concerns raised during scoping. Options originating from scoping comments, Donlin Gold's consideration of design alternatives, and the Corp's EIS contractor, AECOM, were compiled into tables, organized by project component and subcomponent.

In Step 4, screening criteria from Step 2 were applied to the options developed in Step 3. The criteria were used to screen options and to eliminate options that would not meet the Corps' determination of Purpose and Need, that were not feasible, or that would not reduce environmental impacts over similar options. The EIS contractor completed preliminary screening, which was reviewed and refined by the Corps.

Step 5 was to package the options that met all of the screening criteria into action alternatives for detailed analysis in the EIS. Options that were dismissed from further analysis are summarized in Section 2.4. The range of reasonable alternatives is described in Section 2.3.1 through Section 2.3.7.

2.2.1 SCREENING THE FULL RANGE OF ALTERNATIVES

2.2.1.1 SCREENING CRITERIA

The EIS team organized screening criteria around three topic areas: purpose and need, feasibility, and environmental impacts. First, the EIS Team documented and eliminated options clearly outside of the purpose and need. Each remaining option was then rated for feasibility (technical, economic and, where relevant, logistical) and environmental impacts (physical, biological, and socioeconomic).

The final decision to analyze options rested with the Corps in consultation with the cooperating agencies. For any option eliminated from further analysis, the rationale for elimination is documented in Section 2.4, Alternatives Considered but Eliminated from Detailed Analysis.

Alternatives Screening Process

Step 1: *Eliminate Options that Clearly Do Not Meet Purpose and Need*

Step 2: *Determine if Option is Feasible*

- *Identify Technologically Feasible and Operationally Efficient Options*
- *Screen Technologically Feasible Options for Relative Cost Effectiveness*
- *Where Necessary, Evaluate the Logistical Feasibility of Options*

Step 3: *Eliminate Options that Increase Negative Environmental Impacts*

2.2.1.1.1 SCREENING – PURPOSE AND NEED

Three federal agencies have regulatory permitting authority for the project that will require a Record of Decision (ROD): the Corps, the Bureau of Land Management (BLM), and the Pipeline and Hazardous Materials Safety Administration (PHMSA). The Purpose and Need statements for the project are provided in Section 1.3 of the EIS. Options that did not meet the Corps' determination of Overall Purpose and Need and NEPA Purpose and Need were not analyzed further in the EIS. Similarly, any options to the natural gas pipeline component that fall outside the BLM or PHMSA Purpose and Need statements were dismissed.

2.2.1.1.2 SCREENING – FEASIBILITY

The feasibility screening test considers technological, economic and, where relevant, logistical feasibility. Technological feasibility was evaluated to minimize the risk of an option causing a component to be unable to perform its intended function efficiently. Options that make project components too complex or use unproven technology increase the risk of operational failure and accidents.

Options identified for a specific project component may be subject to technical constraints that affect the workability of the option. For example, topography, resource needs, spatial relationships of one component to another, temporal sequences, operating considerations, or engineering data for a specific option may influence whether a particular option is capable of meeting the project objectives. The technological feasibility criterion considers the practicability of each option in meeting these challenges.

Economic feasibility considers the relative cost effectiveness of technologically feasible and operationally efficient component options. If project costs of implementing an option exceed reasonable or practical limits, the option could be considered economically infeasible. CWA regulations enumerate cost as among the considerations to be factored into whether an alternative is practicable (40 CFR 230.10(a)(2)): *"An alternative is practicable if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes…."* In the screening stage, rough order of magnitude cost comparisons were made, as detailed engineering and costs could not reasonably be developed for over 300 options. Where the order of magnitude cost review was not sufficient to decide whether an option was economically feasible, it was advanced for additional review, and additional information gathered before reaching a screening conclusion.

2.2.1.1.3 SCREENING – ENVIRONMENTAL IMPACTS

Based on assessment of likely environmental impacts, including physical, biological, and socioeconomic, the EIS Team eliminated options that had a high potential to increase negative direct environmental impacts and, when appropriate, indirect and cumulative environmental impacts.

2.2.1.2 FULL RANGE OF OPTIONS CONSIDERED

Using the first three steps of the Alternative Development Process described in Section 2.2, the EIS team compiled scoping comments, cooperating agency suggestions, Donlin Gold's consideration of design alternatives, and input from the EIS contractor to form the full range of options for consideration.

The options were gathered into three common primary components of the Mine Site, Transportation Facilities, and Natural Gas Pipeline.

Primary Components

Mine Site: Consists of 13 Subcomponents and 113 Alternative Options

Transportation Facilities: Consists of 9 Subcomponents and 89 Alternative Options

Natural Gas Pipeline: Consists of 5 Subcomponents and 111 Alternative Options

From the full range of options, options that met the three alternatives screening criteria were addressed by the EIS Team in a preliminary assessment and recommendation forwarded for the Corps' consideration. These were then packaged into alternatives for full analysis. The alternatives that were advanced for full analysis for the EIS were then developed to a sufficient level of conceptual engineering to allow impact analysis.

Following conceptual engineering, options were rechecked to ensure they still met the screening criteria. The conceptual engineering work identified feasibility concerns for three of the options initially carried forward:

- Alternative 5B – Comingled Tailings. This was Option MS-75 and would have dewatered the tailings and placed them as a comingled mix with waste rock into the Waste Rock Facility (WRF). The option was ultimately found to be infeasible for reasons documented in Appendix C, Table C-13. Additional detailed documentation of the option is included in Appendix C.
- Alternative 5C – Return Potentially Acid Generating (PAG) 6 Waste Rock to Completed Mine Pit. This was Option MS-60A and would have returned all PAG 6 waste rock to the pit bottom so that it would be later submerged in the pit lake. The option was ultimately found to have little or no potential environmental benefit and infeasible for reasons documented in Appendix C, Table C-13. Additional detailed documentation of the option is included in Appendix C.
- Alternative 6B – Kichatna Pipeline Alignment. This was Option PL-26 and would have deviated around a pipeline segment that is proposed to be constructed near the Iditarod National Historic Trail (INHT). The option was ultimately found to be infeasible for reasons documented in Appendix C, Table C-21. Additional detailed documentation of the option is included in Appendix C.
- Additionally, Alternative 5D – Treat and Discharge Some Excess Water considered using advanced water treatment (AWT) and has been accepted by Donlin Gold as a component of their proposed project. It has been incorporated into the description of the Proposed Action (Alternative 2 – see Section 2.3.2) and is not a stand-alone action alternative.

The alternatives to be advanced for full analysis in the EIS, including the No Action and Proposed Action alternatives, are presented in Section 2.3. The options eliminated from further analysis are listed in Section 2.4.

2.3 DESCRIPTIONS OF ALTERNATIVES

2.3.1 ALTERNATIVE 1 – NO ACTION

NEPA requires consideration of a No Action Alternative. The No Action Alternative means that no permits would be issued and the proposed project would not be undertaken. The No Action Alternative applies to all three components of this project. There would be no mine site development, no transportation facilities, and no natural gas pipeline. The future of the existing camp, airstrip, and related facilities, developed for exploration and baseline environmental studies, would be decided at the discretion of the land owners, The Kuskokwim Corporation (TKC) and Calista Corporation (Calista). There is currently no requirement for the camp and airstrip to be reclaimed should the project not be permitted (Enos 2013a).

The No Action Alternative would result from the Corps not issuing required permits under Section 404 of the CWA and Section 10 of the Rivers and Harbors Act. The No Action Alternative would also result if Donlin Gold chooses not to pursue the project. Under the No Action Alternative, the BLM would deny the requested Mineral Leasing Act (MLA) ROW permits for the natural gas pipeline on BLM-managed lands, and the proposed gas pipeline would not be authorized or constructed. Whether the mine site would move forward would depend on an alternative design not requiring a MLA ROW. The No Action Alternative thus meets NEPA requirements for analysis as well as MLA, CWA, and Rivers and Harbors Act analysis.

The No Action Alternative is intended to be used as a baseline to facilitate the comparison of impacts between the proposed action alternative and the alternatives analyzed in detail. Project-related impacts (both positive and negative) would not occur under the No Action Alternative.

2.3.2 ALTERNATIVE 2 – DONLIN GOLD'S PROPOSED ACTION

This section describes the Proposed Action for the Donlin Gold Project. The proposed Donlin Gold Project would be an open pit, hard-rock gold mine in Southwest Alaska, 10 miles north of the village of Crooked Creek within the Crooked Creek drainage, on land leased from the Calista Corporation, an Alaska Native Claims Settlement Act (ANSCA) regional corporation. The Kuskokwim Corporation, an ANCSA village corporation, has granted surface use rights to Donlin Gold. The proposed mine (including the open pit, the processing plant, WRF, and tailings storage facility [TSF]) would be located on 80,600 acres of land leased from the Alaska Native corporations mentioned above, and the Angyaruaq (Jungjuk) Port and access road on State and ANCSA corporation lands. The project would also include a 315-mile natural gas pipeline within ROWs leased from the State of Alaska, BLM, Calista, and Cook Inlet Region, Inc. (CIRI).

The description of Alternative 2 is based on information provided by Donlin Gold in the following documents:

- Plan of Operations (SRK 2012a through 2012f). This plan is composed of the following volumes:
  - Volume I: Project Description
  - Volume II: Water Resources Management Plan

- Volume III: Integrated Waste Management Plan (Volume III A: Monitoring Plan and Volume III B: Waste Rock Management Plan)
- Volume IV: Reclamation and Closure Plan
- Volume V: Tailings Storage Facility Plan
- Volume VI: Transportation Plan
- Volume VI A: Terminal and Tank Farm Oil Discharge Prevention and Contingency Plan
- Volume VI B: Vessel Operations Oil Discharge Prevention and Contingency Plan

- River Barge Fleet Design and Operation (AMEC 2013)
- Revised Pipeline Plan of Development (SRK 2013b)

The proposed Donlin Gold project would require three to four years to construct and have an active mine life of approximately 27.5 years. The mine is proposed to be a year-round, conventional truck and shovel operation using both bulk and selective mining methods. The mine operation would have a projected average mining rate of 422,000 short tons per day (stpd). (The term “short ton” refers to the English unit of measurement comprising 2,000 pounds and contrasting with the term “tonnes” which refers to the metric measurement comprising 1,000 kilograms. In this EIS, the term “ton” is used with the same meaning as the term “short ton.”) Total waste rock material is estimated at 2.99 billion tons, with approximately 2.46 billion tons to be placed in a waste rock facility located outside the mine pits and the remaining waste rock backfilled in the ACMA pit.

The ore processing facilities would operate at an average production rate of 59,000 stpd. Milling components include a gyratory crusher, semi-autogenous grinding (SAG) and ball mills, followed by flotation, concentration, pressure oxidation, and carbon-in-leach (CIL) process circuits. Carbon stripping, electrowinning, and refining would produce an end product of gold doré bars, which would be shipped to a custom refinery for further processing. State-of-the-art mercury abatement controls would be installed at each of the major thermal sources, including the autoclave, carbon kiln, gold furnaces, and retort. Tailings storage would encompass an area of 2,351 acres with a total capacity of approximately 335,000 acre-feet of mill tailings, decant water, and stormwater in a fully-lined facility.

Electrical power for the proposed Donlin Gold project would be generated on site from a dual-fueled reciprocating engine power plant with a steam turbine utilizing waste heat recovery from the engines. Natural gas would be the primary fuel with diesel as backup. The power plant would comprise two equal halves, each consisting of six reciprocating engines, and a single separate steam turbine for a total installed capacity of 227 MW, an average running load of 153 MW, and a peak load of 184 MW. Natural gas would be transported to the Donlin Gold mine site via a 315-mile, 14-inch diameter buried steel pipeline originating from an existing 20 inch natural gas pipeline near Beluga, Alaska.

General cargo for operations would be transported to Bethel by marine barge from terminals in Seattle, Washington, Vancouver, BC, or Dutch Harbor, Alaska. At Bethel, cargo would be transferred to the dock for temporary storage or loaded onto river barges for transport up the Kuskokwim River to a port constructed at Jungjuk Creek. A 30-mile all-season access road would be constructed from the proposed Angyaruaq (Jungjuk) Port to the mine site. Fuel would be transported to Dutch Harbor by tanker, then to Bethel by marine barge. At Bethel fuel would either be transferred directly to double-hull river barges for transport to Angyaruaq (Jungjuk) Port, or be off-loaded for temporary storage. From Angyaruaq (Jungjuk) Port fuel would be delivered to the mine site fuel storage facility by tanker trucks.

The Donlin Gold project site would be a permanent camp operation accessible primarily by a 5,000-foot gravel airstrip. The camp would be capable of housing up to 638 workers during operations.

Reclamation and closure planning has been based on the concept of "design for closure," which was initiated in the very early stages of the Donlin Gold project development to address post-closure impacts on the physical resources of the area and on local communities. In addition to reclaiming disturbances associated with mining, processing, and ancillary support facilities in a manner compatible with the designated post-mining land use, the goal of the Donlin Gold reclamation plan is to minimize the area affected by operations. During operations, concurrent reclamation would be performed whenever possible in areas no longer required for active mining.

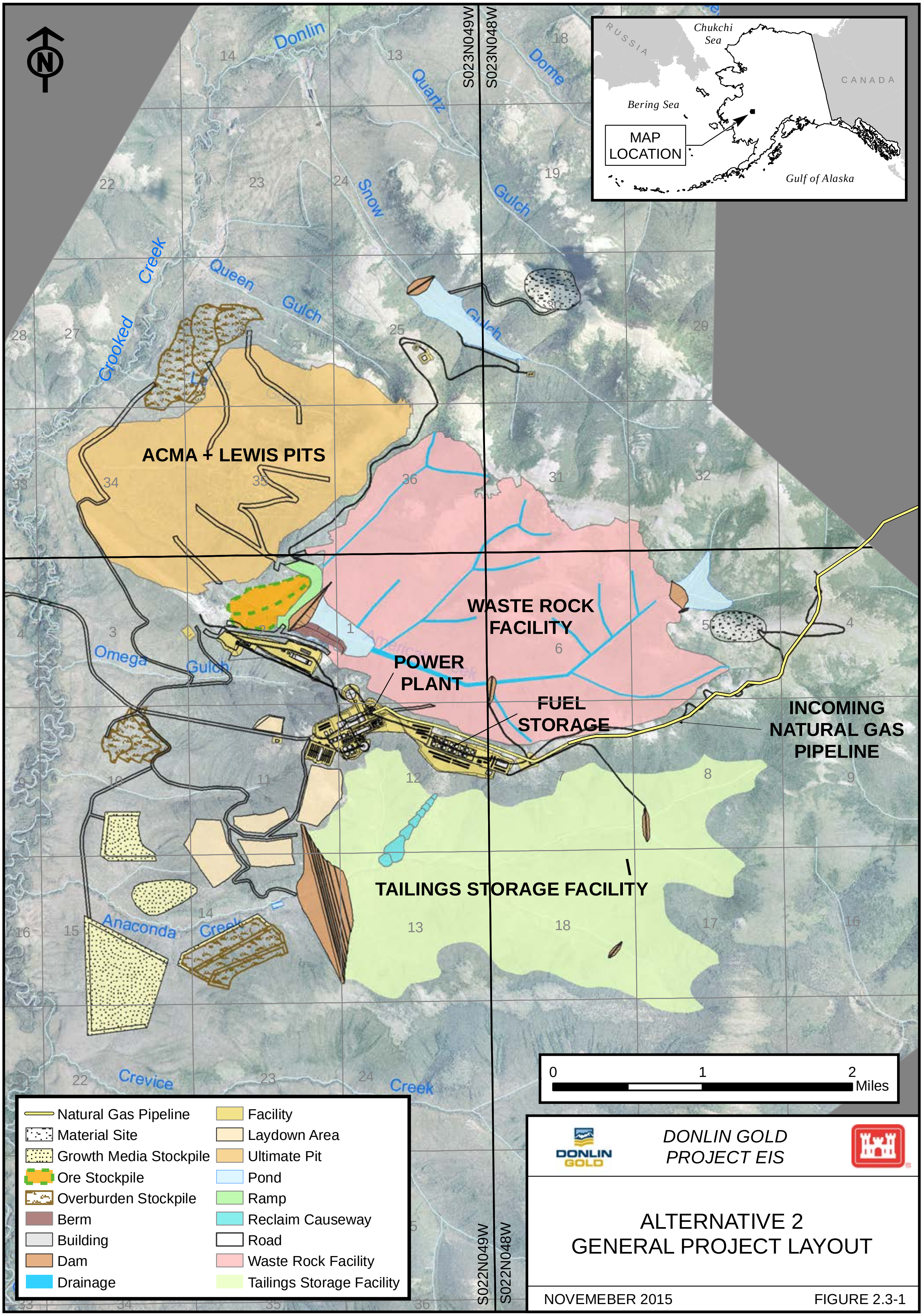
2.3.2.1 ALTERNATIVE 2 – MINE SITE

The mine site component includes two open pits, a waste rock facility (WRF), ore processing facilities, a tailing storage facility (TSF), water treatment plants, facilities to house the workforce, equipment to transport ore from the open pit to the processing plant, hydrologic control features (freshwater diversion dams, contact water dams, and a freshwater reservoir), and a power plant. Mine site equipment and facilities include:

- Construction camps (temporary) to provide living quarters for up to 2,560 workers, support facilities, warehouse and storage space, a water treatment and waste disposal system, communication facilities, and power generation facilities. During operations and maintenance, the permanent camp would house 638 workers.
- Open pit mining would require drilling, blasting, loading, and hauling equipment; haul roads and access roads; TSF; WRF; overburden stockpiles; and growth media stockpiles within the mine site.
- Mine equipment used at the mine during construction and operations includes wheel loaders, dozers, drills, shovels, and haul trucks. Auxiliary mine equipment includes: blast hole drills, blasting emulsion trucks, dozers, service trucks, transport vehicles, and trailer-mounted lights (see Table 2.3-1).
- The mine operation would have a projected average mining rate of 422,000 stpd. Total waste rock material is estimated at 2.99 billion tons, with approximately 2.46 billion tons to be placed in a waste rock facility located outside the mine pit and the remaining waste rock backfilled in one of the pits. Total tailings are estimated at 568 million tons with a density of 78 pounds per cubic foot to be placed in a conventional slurry tailings facility.
- Processing facilities to crush and grind ore for feed to flotation, flotation concentrate pressure oxidation, carbon-in-leach circuit, gold recovery, tailings management and recycle water management.

- Mercury abatement would occur at all mercury emission sources in the processing facility. All mercury would be transported in specially designed and marked mercury containers that would be managed in accordance with the mercury management plan and state and federal requirements.
- Sodium cyanide handling and storage procedures would be in accordance with state and federal requirements and the International Cyanide Management Code (ICMC) as developed by the International Cyanide Management Institute.
- Power would be provided by a dual fuel power plant. Power from the plant would be distributed to the main process areas of the mine by power cables and overhead transmission lines.
- Eight freshwater wells would be drilled south of Omega Gulch, near Crooked Creek, to supply domestic and sanitary water supplies. Two wastewater treatment plants (WTP) would be installed at the mine site.
- At the ACMA and Lewis open pits, there would be up to 35 pit perimeter wells and 80 in-pit dewatering wells. Some pit dewatering groundwater would be treated to meet Alaska Department of Environmental Conservation (ADEC) Water Quality Standards and discharged to Crooked Creek; the remainder would be used in the processing facilities.
- Hazardous waste would be managed at the mine site through the hazardous waste classification system described in federal regulation 40 CFR Part 262 under the Resource Conservation and Recovery Act (RCRA).

The Proposed Action would have an average process throughput rate of 59,000 tons of ore per day, an estimated operational life of 27.5 years, and would produce approximately 30 million ounces of gold. The gold within the Donlin Gold deposit is not visible to the human eye; it is microscopic and bound within the arsenopyrite (iron arsenic sulfide) and pyrite (iron sulfide) minerals within the host rock of the deposit. Donlin Gold proposes to mine the deposit through a combination of bulk and selective, open pit, hard-rock mining methods. Bulk mining methods are typically used in massive ore bodies with a relatively homogenous (and lower grade) distribution of gold within the host rock. Selective mining methods would be employed in areas where ore grades are higher or where local geology has produced irregularities in the ore body. The mine site would occupy a total area of approximately 14 square miles (9,000 acres). Figure 2.3-1 presents a general layout of the proposed mine site.



DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
GENERAL PROJECT LAYOUT

NOVEMEBER 2015

FIGURE 2.3-1

2.3.2.1.1 MINE SITE – FACILITIES CONSTRUCTION

Construction Sequence

Site access, preparation, and clearing activities would take place after the completion of the permitting process to facilitate construction at the mine site. During pre-production, Donlin Gold would gain access to the site; erect a temporary construction workforce camp; prepare for full-scale mining operations; train work crews; install erosion controls; construct access and haul roads; and clear and grub the pit, TSF, waste rock storage, and process facilities areas that would be utilized during the initial years of operation. Staging of equipment would be one of the first activities undertaken. Construction of facilities and removal of overburden to provide access to ore is anticipated to take 3 to 4 years to complete working year round.

Construction Camp

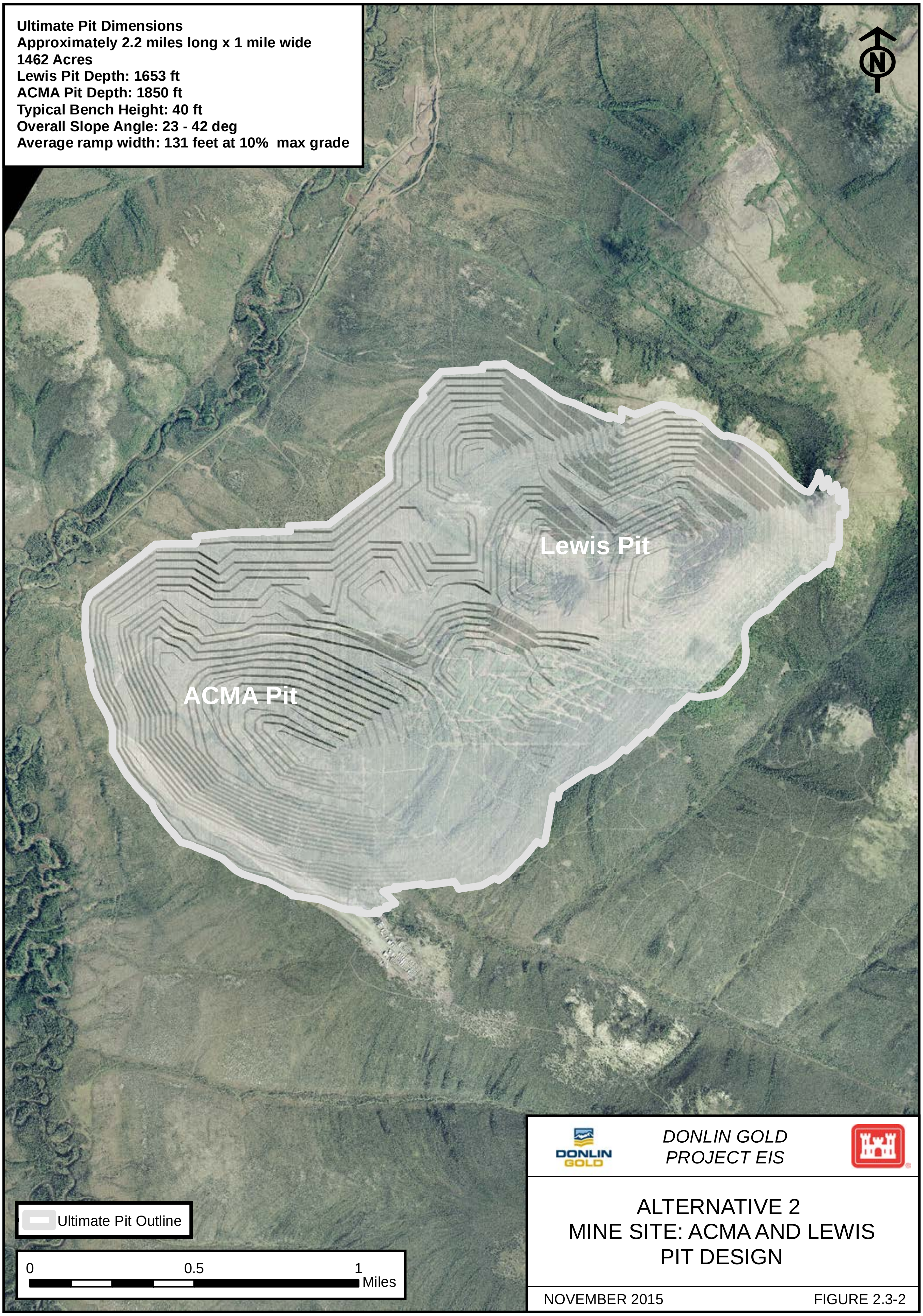
The construction camp would be near the processing plant site (see Section 2.3.2.1.10 for a description of the permanent accommodation camp). The main building would include 14, 3-story dormitories designed to accommodate shift workers during construction of the mine. Building modules would be transported by barge to the Angyaruaq (Jungjuk) Port facility and then transported via truck to the construction camp site. Construction camp modules would be disassembled and removed after construction is complete. The construction camp would occupy approximately 15 acres. The separate construction camps for the pipeline are described in Section 2.3.2.3.5.

Construction Workforce

The estimated peak construction workforce for the mine site is 2,560. Information on the pipeline construction workforce is provided in Section 2.3.2.3.5.

2.3.2.1.2 MINE SITE – MINING METHODS

Gold-bearing rock within the Donlin Gold deposit is present in two adjacent areas known as the ACMA and Lewis deposits. The ACMA pit would have an ultimate depth of approximately 1,850 feet and the Lewis pit would be 1,653 feet deep from the upper high wall to the final pit bottom. Mining of the ACMA pit is proposed in nine phases and the Lewis pit in six phases. The initial mining of the two pits would be independent, but they would partially merge later in the life of the mine into one roughly oval, open pit mine with dimensions roughly 2.2 miles long by 1 mile wide (Figure 2.3-2). Pit slope angles between in-pit roads would be determined according to rock strength and would range between 26 and 50 degrees. Mine equipment will access the pit via ramps which have been designed at grades no steeper than 10 percent. Catch benches have generally been designed every 80 vertical feet in most areas of the pit at varying widths to meet slope design criteria, allow for catchment of loose material, and potentially allow access for bench maintenance and observation (Figure 2.3-3).



DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
MINE SITE: ACMA AND LEWIS PIT DESIGN

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FIGURE 2.3-2

Goldstrike Betze Mine
Source: AECOM, 2015

DONLIN GOLD

DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
OVERVIEW OF OPEN
PIT BENCHES

NOVEMBER 2015

FIGURE 2.3-3

2.3.2.1.3 LOADING AND HAULING EQUIPMENT

Open pit mining would use a fleet of shovels, wheel loaders, drills, large-capacity haul trucks, and a variety of auxiliary equipment. Haul roads would be required between the two pits, the ore crusher, the WRF, overburden stockpiles, construction areas, and the truck shop. During mine operation, hydraulic shovels would be the primary loading equipment, supported by front-end loaders. Auxiliary mine equipment would include track dozers, wheel dozers, water trucks, graders, excavators, small wheel loaders, blasting product trucks, service trucks, transport vehicles, cranes, and trailer-mounted light plants. A list of the types and numbers of equipment proposed to be used at the project is presented in Table 2.3-1.

Auxiliary fleet vehicles would be used for road maintenance, bench development in the open pit, construction of the WRF, and miscellaneous mine site projects. Graders would maintain the haul roads, including the mine access road. Water trucks would spray roads and working areas to mitigate dust impacts to air quality.

Blasting

Blasting would be required to fracture and loosen rock prior to excavation. Blasting operations would be conducted daily and in accordance with a blasting plan. Blasting agents would consist of a combination of emulsion and ammonium nitrate and fuel oil (ANFO) explosives. Blasting materials would be used during both construction and mining operations.

Separate storage bins or silos would be constructed for emulsion, ammonium nitrate, and fuel oil. Blasting materials would be stored and handled according to the Mine Safety and Health Administration (MSHA) regulations in 30 CFR Part 56. Explosives would be handled and transported according to the regulations of the Bureau of Alcohol, Tobacco, Firearms, and Explosives; U.S. Department of Transportation (USDOT) PHMSA; and the U.S. Coast Guard (USCG). All detonators and bagged products would be stored in an explosives magazine meeting applicable federal and state safety and security requirements.

2.3.2.1.4 MINE SITE – ORE PROCESSING

Ore processing involves sequential steps after the ore has been transported from the open pit to the nearby facilities. The process steps to break down the ore into fine particles allowing gold to be separated from the host rock and producing doré bars— summarized on Figure 2.3-4 and Figure 2.3-5 — include crushing and grinding, flotation, pressure oxidation (POX), cyanide leaching, stripping, electrowinning, refining, cyanide detoxification, and tailings storage.

Crushing and Grinding

The crushing and grinding facilities would operate continuously except for scheduled maintenance or unforeseen downtime. Ore would be crushed to 80 percent passing 5 inches in a primary gyratory crusher installed near the ACMA pit and conveyed 0.72 miles to the coarse ore stockpile near the process facilities. The coarse ore stockpile would be enclosed within an insulated steel structure to control dust emissions and minimize exposure of the ore to precipitation. The stockpile would have a live capacity of 42,000 tons, approximately the amount of coarse ore needed to operate the processing facilities for 16 hours.

Table 2.3-1: Primary Mine Equipment Information (Estimates)

Make and Model (Typical)	Type	Engine[1]	Rating (hp)	Maximum Units Operating
Komatsu PC8000	Hydraulic shovel (electric or diesel)	2 x squirrel-cage induction motors or 2 x Komatsu SDA16V160	3,890 (electric) or 4,020 (diesel)	7
LeTourneau L2350	Front-end loader	MTU/DD 16V4000	2,300	2
Caterpillar 994F	Front-end loader	Cat 3516B	1,577	1
Liebherr T282C	Haul truck	MTU/DD 20V4000	3,755	69
Caterpillar 785C	Haul truck	Cat 3512B	1,450	10
Atlas Copco PV 275	Drill	Cat C32 ACERT	950	7
Atlas Copco DML	Drill	Cat C27 ACERT	800	15
Atlas Copco L8	Drill	Not specified	540	10
Caterpillar D11T	Track dozer	Cat C27 ACERT	850	6
Caterpillar D10T	Track dozer	Cat C32 ACERT	646	4
Caterpillar 854G	Wheel dozer	Cat C32 ACERT	904	6
Caterpillar 24H	Grader	Cat C13 ACERT	533	3
Caterpillar 16H	Grader	Cat C18 ACERT	297	7
Caterpillar 785C	Water truck	Cat 3512B	1,450	4
Caterpillar 390DL	Hydraulic excavator	Cat C18 ATAAC	523	2
Komatsu PC2000	Hydraulic excavator	Not specified	976	2
Caterpillar 777F	Fuel truck	Cat C32 ACERT	1,016	3
QTE Body on Peterbilt Chassis	Service truck	Not specified	300	1
Grove GMK6350 (200T)	Mobile crane	Benz OM906LA	563	1
QTE Body on Peterbilt Chassis	Low boy truck	Not specified	300	1
Caterpillar 988	Tire handler	Not specified	501	2
Terex LT7000	Light plant	Not specified	25	20
Blue Bird GSA	Bus	Not specified	300	Not estimated at this time
Ford F-150	Light vehicle	Not specified	411	Not estimated at this time
Caterpillar T660	Water truck	Not specified	550	Not estimated at this time

Abbreviations:

hp = horsepower

1 All equipment would be diesel-powered except for the electric shovels.

Source: Fernandez 2013b.

From the coarse ore stockpile, the ore would be fed to a semi-autogenous grinding (SAG) mill that grinds the ore in water to 80 percent passing 6 mesh (3.3 mm) and transfers the ground slurry to a sump. A ball mill and cyclones operate in closed circuit to produce ore ground to 80 percent passing 100 mesh (150 microns [µm]) for primary rougher flotation.

Ore Processing Terminology

Refractory *– A term used to indicate a difficult-to-treat ore that requires some form of pre-treatment to liberate gold or other precious metals before the ore can be further processed to recover them.*

Flotation *– Flotation is the process of using minute amounts of chemicals, separating sulfide minerals from ore by inducing them to gather in and on the surface of a froth layer within a flotation cell. This process recovers the sulfide minerals containing the gold, which are then skimmed off the top of the flotation cells. Spent ore (tailings) is sent to a tailing storage facility.*

Pressure oxidation (POX) *– Pressure oxidation is a process for pre-treating ore or concentrates using elevated temperatures, pressures, and oxygen to oxidize sulfide materials to expose the valuable minerals encapsulated within the sulfides.*

Autoclave *– An autoclave is the equipment used to oxidize sulfide minerals. It is constructed of specialized materials to withstand the conditions necessary to oxidize the sulfides.*

Cyanidation *– A chemical reaction that uses dilute cyanide-containing solutions and oxygen to selectively solubilize (leach) gold or other precious metals from the ore or concentrate, making these metals available for separation.*

Activated carbon *– Carbon manufactured to enhance surface characteristics that attract and promote gold adsorption, removing gold from solution.*

Carbon-in-Leach (CIL) *– Carbon-in-leach is the process of leaching gold and other precious metals (if present) in agitated tanks in the presence of activated carbon particles. The gold-loaded carbon is then physically separated for further processing to recover the adsorbed gold.*

Stripping *– The separated carbon is treated by changing solution chemistry to remove (strip) the gold from carbon and concentrate the soluble gold in solution.*

Electrowinning (EW) *– A process for the deposition of metals by electricity out of metal-bearing solution.*

Refining *– Plated gold is transferred to a separate area and treated by melting the gold, silver and any other precious metals. In this process, impurities are removed.*

Doré *– Bars of semi-pure gold, silver and other precious metals that contain residual quantities of impurities.*

Flotation

The 100 mesh ore from the primary grinding circuit would be mixed with reagents (see Section 2.3.2.1.6), water, and air to facilitate the process of separating the gold-bearing material from the ore. The air bubbles collect the gold-bearing sulfides on their surfaces and rise to the top, forming a mineral-laden layer (froth), which is scraped from the surface into a concentrate.

The tailings from the primary rougher flotation process would be further ground (80 percent passing 270 mesh [50 µm]) in a ball mill in closed circuit with cyclones to prepare the material for secondary rougher flotation.

Auxiliary fleet vehicles would be used for road maintenance, bench development in the open pit, construction of the WRF, and miscellaneous mine site projects. Graders would maintain the haul roads, including the mine access road. Water trucks would spray roads and working areas to mitigate dust impacts to air quality.

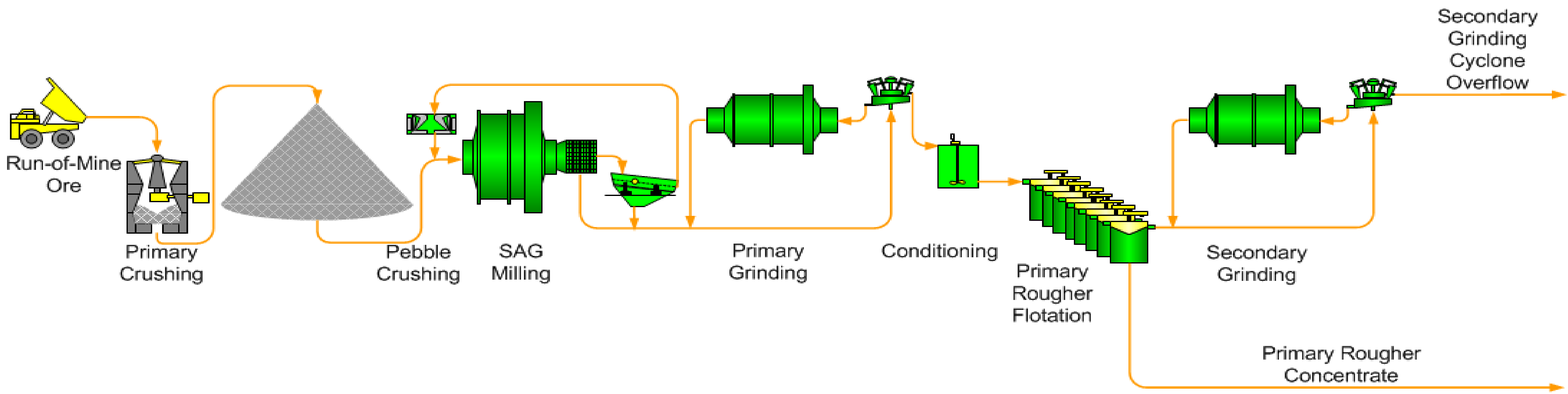
Secondary rougher flotation would be comprised of three circuits: the secondary rougher flotation circuit, the cleaner flotation circuit, and the cleaner scavenger circuit. Final concentrate recovered from the secondary rougher flotation would be combined with concentrate from the primary rougher flotation.

The combined flotation concentrate, representing approximately 15 percent of the mill throughput, would then be sent through an acidulation circuit where acidic solution from the autoclave discharge would be added to lower the pH of the slurry and neutralize the natural carbonates prior to being sent to the POX circuit.

The tailings from the secondary rougher flotation would be combined with the primary rougher flotation tails from the secondary grinding circuit and these cleaner scavenger tails are sent to the flotation tailings thickener to remove some of the water from the slurry for reuse in the process.

The flotation tailings are then utilized for quenching autoclave off gas prior to being sent to the neutralization circuit.

The neutralization potential of the flotation tailings is utilized to modify the pH of the autoclave discharge solution prior to being transported via a pipeline to the TSF.



DONLIN GOLD

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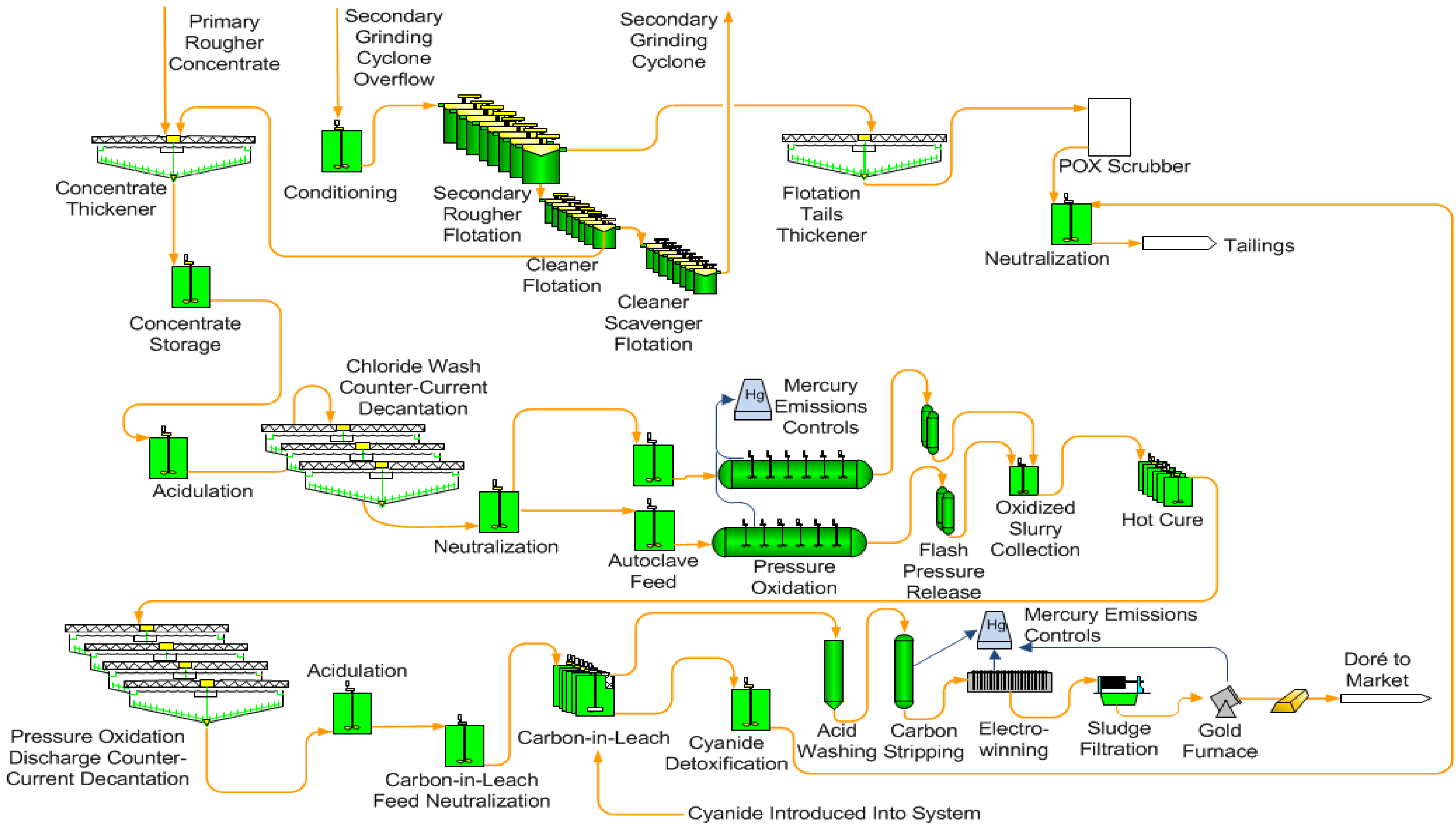
ALTERNATIVE 2
ORE CRUSHING
AND GRINDING

NOVEMBER 2015

FIGURE 2.3-4



DONLIN GOLD

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ALTERNATIVE 2
ORE PROCESSING

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FIGURE 2.3-5

Pressure Oxidation

POX is a pre-treatment unit operation used to process refractory ores or concentrates where gold is contained in sulfide minerals by oxidizing the sulfides and exposing gold particles. POX is conducted in autoclaves lined with acid and abrasion-resistant bricks. The autoclaves use elevated temperature and pressure, and oxygen to oxidize the gold-bearing sulfide minerals. The chemical process inside the autoclave would convert gold-bearing sulfide minerals (i.e., FeS) to gold-bearing oxide minerals ($FeSO_4$). The pressure and temperature in the autoclaves combined with the injection of a high purity oxygen gas would oxidize the sulfide mineral complex, thus allowing gold to be extracted in the subsequent cyanide leaching process. Cooling water and steam would be used to control the operating temperature within the autoclaves. Gas vented from the autoclaves would be cooled and sent to the mercury abatement system. The oxidized flotation concentrate would be thickened and washed in a counter-current-decantation (CCD) circuit to reduce the acid content. Residual acid in the thickener overflow would be mixed with flotation tails.

Carbon-In-Leach Cyanide Leaching

The thickened solids from CCD would be sent to the cyanidation circuit. Carbon-in-leach (CIL) cyanide leaching would use sodium cyanide solution to dissolve the microscopic gold and separate it from the oxide minerals produced during the POX process. During the CIL process, the gold in solution would be adsorbed onto the activated carbon particles. Periodically, carbon loaded with gold would be screened from the depleted fine rock and transferred to holding vessels before further processing. After stripping (desorption of gold from carbon), the barren carbon particles would be re-generated using high temperatures in a rotary kiln to remove organic contaminants and to capture mercury. Spent carbon that could no longer be recycled into the process would be sent off-site to an approved waste facility for processing and storage.

Stripping, Electrowinning and Gold Refining

During the refining process, gold would be stripped from the loaded (gold-bearing) carbon removed from the CIL process. The pregnant (gold-bearing) solution from the stripping process would be circulated through electrowinning (EW) cells where gold is plated onto cathodes. The gold-bearing material from EW would be treated in a retort (heated air-swept chamber) to dry the material and remove mercury. The off gas from the retort is cooled to condense mercury and then passes through sulfur-impregnated carbon columns to capture any residual mercury. The retorted gold material would then be melted in an induction furnace and poured into doré bars prior to being shipped off-site for final refining and purification. Doré bars are composed of a semi-pure alloy of gold and silver that requires further refining to purify. Doré bars would typically be 80-85 percent gold prior to off-site purification.

Cyanide Detoxification and Discharge to Tailings Storage Facility

The screened CIL slurry discharge would be treated in a cyanide detoxification process using SO_2/air technology. A sulfur burner would provide the SO_2 gas which is used to detoxify residual cyanide from the CIL process. Two tanks operating in series would provide two hours retention for cyanide detoxification. SO_2 gas would be added at a rate sufficient to reduce the weak acid dissociable cyanide (CN_{WAD}, referring to those cyanide species measured by specific analytical techniques) levels in the tailings to $\leq$10 parts per million (ppm) prior to discharge to the TSF. Lime slurry would be added as needed to provide pH control, and copper sulfate solution would be added as a reaction catalyst. Concentrations of major constituents expected in the tailings pond water are presented in Table 3.7-33 in Section 3.7.3.2.1.

2.3.2.1.5 MINE SITE – MERCURY ABATEMENT

Mercury is a naturally occurring element found within the Donlin Gold deposit as cinnabar (or mercuric sulfide or HgS). When ore containing mercury is processed, mercury will be released and must be captured for proper disposal. During the ore processing, volatized mercury would be separated and recovered. Donlin Gold estimates the mine would remove approximately 34,600 pounds of mercury per year from the gaseous waste streams.

There are six points in the process at which mercury controls are in place for gaseous emissions:

1. Pressure oxidation;
2. Hot cure;
3. Electrowinning;
4. Retort;
5. Refinery furnace; and
6. Carbon regeneration kiln.

Mercury would be collected and disposed of in two forms: liquid elemental mercury and mercury impregnated carbon. Both forms would be shipped off-site by barges to a permanent, federally-approved, mercury storage facility. The efficiency of the mercury controls is shown in Table 2.3-2.

Table 2.3-2: Mercury Control Efficiency

Mercury Control Point	Mercury Removal Efficiency
Pressure oxidation;	99.9%[1]
Hot cure	99%[2]
Electrowinning	99%[1]
Retort	99%[1]
Refinery furnace;	99%[1]
Carbon regeneration kiln	99%

Sources: SRK 2014a, Hatch 2014.

Pressure Oxidation

Gaseous emissions are generated from the autoclave circuits at three points: the autoclave vent, flash vessel vents, and the oxidized slurry seal tank vent. The gaseous emissions from each of the two autoclave circuits are treated using vent gas cyclones, slurry heater vessel, vent gas quench vessel, barometric condenser, vent gas scrubber, and carbon bed. The vent gas cyclones capture a fraction of entrained particulate carryover and return it to the process slurry for downstream processing. The cyclones are not intended as a mercury control device. The vent gas cyclone discharges through the slurry heater vessel which is utilized as a direct contact heat exchanger to pre-heat the autoclave feed slurry. The slurry heater vessel is not considered a mercury control device. Gas from the slurry heater vessel, oxidized slurry seal tank, and the autoclave pass through the vent gas quench vessel. Flotation tailings slurry is used as a quenching medium in direct contact with the gases. The quenching process promotes reduction in gas volume and potential for further removal of particulate material due to reduced gas superficial rise velocities in the vessel. The remaining gas from the vent gas quench vessel is ducted to a barometric condenser. The gas is directly contacted with water injected into the vessel through a series of spray nozzles. The water cools the gas and further reduces the volumetric gas flow. The heated water underflow from the condenser is reused in the process as wash water. A venturi scrubber (vent gas scrubber) is used to remove particulate matter from the barometric condenser vent gas. Particulate separation is achieved by accelerating the gas through the vessel and the addition of water. The heated water underflow is reused in the process as wash water.

Mercury removal for all pressure oxidation vent gas streams is primarily performed in a carbon bed through adsorption on activated carbon. There are five stages for effective mercury removal within the carbon beds: dilution and humidity control, particulate removal, pre-cleaning (volatile organic compound [VOC] removal), primary mercury removal, and secondary mercury removal. Gas from the vent gas scrubber is diluted with heated ambient air to lower the gas relative humidity for effective adsorption of mercury on the activated carbon. Particulate removal from the diluted gas stream is achieved using a bank of high-efficiency filters within the carbon bed vessel. The gas then passes through a bank of high-efficiency particulate air (HEPA) filters. The pre-cleaning bank of carbon uses activated carbon to adsorb VOCs from the gas. VOCs are products of processing flotation concentrate and would otherwise adsorb on the carbon intended for mercury removal. The first stage of mercury removal occurs following VOC removal. The primary mercury removal bank is filled with a sulfur-impregnated carbon that captures mercury through chemical adsorption (chemisorption). The mercury combines with the sulfur in the carbon to form a stable mercury sulfide compound (cinnabar). The primary mercury removal bank is designed to perform all of the mercury removal within the carbon bed. The carbon bed vessel contains a secondary mercury removal bank to provide additional mercury removal capacity (retention time). This essentially serves as a buffer capacity to ensure that emissions are always kept to a minimum.

Hot Cure

The hot autoclave discharge slurry (oxidized material) upon passing through the flash vessels and the oxidized slurry seal tank enters the hot cure tanks. A gaseous emission is expected at the hot cure tanks as a result of steam generated due to a pressure drop through the system. Hot cure steam is processed in two stages of mercury abatement equipment: condenser and carbon bed. The condenser is expected to condense the majority of the vent steam and reduce the vent volume. As a preventive measure, a carbon filtration unit with a filter for particulate removal and a bed of sulfur-impregnated carbon for chemical adsorption of mercury will be installed.

Electrowinning

The vent from the EW cells combined with the barren solution tank vent, cathode wash tank vent, barren and pregnant eluate tank vents, carbon dewatering screen vent hood, carbon regeneration kiln hopper vent hood, and the retort area vent hood is processed in two stages of mercury abatement equipment: demister and carbon bed. The gas passes through a demisting vessel to remove entrained water droplets. If mercury is collected in the vessel, it is able to be separated by gravity and drained into a flask for disposal. Demisted vent gas proceeds to a carbon bed containing sulfur-impregnated carbon for mercury removal.

Retort

The gold-bearing material produced in EW is processed in a retort. The retort removes moisture and mercury from the material by elevating the temperature and air sweeping the chamber. The vent gas from the retort is processed in two stages of mercury abatement equipment: condenser and carbon bed. The condenser vessel is an indirect shell-and-tube heat exchanger that reduces the gas temperature and condenses elemental mercury. Mercury is collected at the bottom of the condenser and drained into a storage flask for disposal. The vent gas proceeds to a carbon bed containing sulfur-impregnated carbon for final mercury removal after the liquid mercury has been removed.

Refinery Furnace

A fume hood over the furnace collects vapor generated from the process which could contain mercury. Gas is drawn through the off-gas equipment using an extraction fan. The vent is processed in three stages of mercury abatement equipment: baghouse, HEPA filter, and carbon bed. The fume hood vent is first passed through a baghouse to remove the majority of entrained particulate matter. The solids recovered are reprocessed in the refinery for precious metal content. Smaller particles remaining in the vent gas are removed using a HEPA filter. This material is also collected and reprocessed in the refinery. The vent gas then proceeds to a carbon bed containing sulfur-impregnated carbon for mercury removal.

Carbon Regeneration

Carbon from which gold has been stripped is processed in a carbon regeneration kiln for reuse in the cyanide leaching circuit. The carbon regeneration kiln removes residual moisture, VOCs, and mercury by subjecting the carbon to high temperatures. The vent from the carbon kiln combines with the vents of the acid wash columns, the acid wash tank, the caustic tank, the spent solution tank, and the strip columns. The combined gas is processed in four stages of mercury abatement equipment: carbon knockoff box, off-gas cooler, mercury collection tank, and carbon bed. Vent gas is first passed through the carbon knockoff box to remove fines that are entrained in the gas. The carbon knockoff box vent passes into the off-gas cooler which is an indirect shell-and-tube style heat exchanger. The elemental mercury is condensed (liquefied) from the vent gas. The cooled vent gas and liquid mercury exit the off-gas cooler and enter the mercury collection tank. The vent gas rises and exits through a demisting section removing entrained droplets and mercury. The mercury is drained from the tank into a flask for disposal. The vent gas proceeds to a carbon bed containing sulfur-impregnated carbon for final mercury removal.

Tailings Storage Facility

Carbon-in-leach tailings are detoxified, combined with flotation tailings in neutralization, and transported to the TSF. There is a possibility that any remaining mercury in the tailings solution could be released as a gaseous emission. A mercury suppressant in the form of UNR 829 would be introduced at the TSF reclaim water header to precipitate residual mercury remaining in solution as an insoluble sulfide-mercury particle.

2.3.2.1.6 MINE SITE – REAGENTS

Reagents would be used at the mine site during the ore processing and refining processes. Reagents are used to concentrate gold-bearing minerals, and to facilitate the process of separating gold from waste rock. Table 2.3-3 lists reagents, estimated annual consumption, and their use in the ore processing and gold refining process.

Table 2.3-3: Estimated Annual Consumption of Reagents Used at the Mine Site

Reagent	Estimated Annual Consumption (Short Tons)	Process Use
Potassium Amyl Xanthate	4,189	Used during flotation to separate and concentrate sulfide minerals
Methyl Isobutyl Carbinol and F-549	1,984	Used during flotation as a frothing agent
Nitric Acid	661	Used to wash carbon during refinery process
Sodium Cyanide	2,535	Used to dissolve gold in CIL process
Lime	21,027	Used to control the pH of oxide minerals for CIL leaching, cyanide detoxification, and to balance the pH of tailings
Activated Carbon	220	Used to absorb dissolved gold in leaching, and in mercury abatement
Caustic soda (Sodium hydroxide)	358	Used to raise the pH in the strip circuit, for mixing cyanide, and to neutralize spent acid solution used in acid-washing carbon
Mercury Suppressant (UNR 829)	44	Used to reduce the soluble mercury levels leached into solution from the autoclave process
Flocculants	3,527	Used to accelerate settling of solids in the thickening of tailings, chloride wash, flotation concentrate, and POX wash
Sulfur	1,414	Used in the cyanide detoxification process
Copper sulfate	2,425	Used during flotation and as a catalyst in cyanide detoxification
Fluxes (borax, sodium nitrate, and silica sand)	165	Used in the preparation of furnace charges for assaying or refining
Water Softening and Anti-Scalant Agents	1,064	Added to process water to reduce levels of dissolved calcium, magnesium, manganese, and ferrous iron, and to prevent scaling in pipes

Source: Fernandez 2013a.

2.3.2.1.7 MINE SITE – WATER MANAGEMENT AND REQUIREMENTS

Water management at the mine site incorporates a number of different structures and strategies. Water balance modeling based on local precipitation and stream flow data has been utilized to optimize water use, reuse, storage, and release at the site.

The mine site is expected to operate with an annual water surplus during operation based on estimated water requirements, as well as the large amount of runoff anticipated from the American and Anaconda Creek basins that would be captured in major project facilities. Most water that comes into contact with mining infrastructure would be reclaimed for use in ore processing. Excess contact water would be treated and discharged under an Alaska Pollution Discharge Elimination System (APDES) permit.

Contact Water

Contact water includes "mine drainage" defined in 40 CFR 440.132(h) as "any water drained, pumped, or siphoned from a mine".

It would include runoff and seepage from the waste rock facility, runoff and seepage from ore stockpiles, and water from horizontal drains that accumulate in the open pit.

It would not include water from the pit dewatering wells.

Four sources of water would be treated and discharged under the anticipated APDES permit:

- Pit dewatering groundwater collected in the pit perimeter and in-pit dewatering wells;
- Groundwater collected from the TSF underdrains and SRS. This would include groundwater originating upslope of the areas covered by the TSF liner and any seepage through the liner;
- CWD water. Sources of this water would include open pit drainage (direct precipitation falling on the pit walls and flows from horizontal pit drains), seepage and runoff from the WRF; seepage and runoff from the South Overburden Pile, and undiverted runoff from undisturbed areas in the American Creek drainage; and
- TSF pond water (net precipitation collected in the TSF pond).

To achieve effluent characteristics in compliance with APDES permit limits, advanced water treatment (AWT) would be conducted as follows:

- Primary treatment by precipitation in a High Rate Clarifier (HRC) after addition of ferric sulfate;
- The HRC would flow to a Greensand Filter to remove TSS and dissolved arsenic;
- The Greensand Filter water will pass through ultrafiltration media; and
- Then to Reverse Osmosis as needed.

The water treatment plant would be designed for a peak treatment rate of 4,671 gallons per minute (gpm) and an average rate of 2,946 gpm. The discharge location would be to Crooked Creek below Omega Gulch.

As part of the overall water management strategy, structures would be constructed to divert stormwater away from facilities where needed to control storage volumes, erosion, and the amount of mine contact water requiring treatment and discharge. Sufficient water storage capacity would be present to account for the possibility of successive years of drought as well as to manage water during wet years. The various components of the water management system at the site are described below.

Pit Dewatering Wells

Wells around the perimeter of the ACMA and Lewis pits would remove groundwater during pre-construction, construction, and operations to aid in stabilizing pit walls and to allow safe mining conditions. Additional wells would be installed in the pit at lower elevations as the pit deepens. While dewatering groundwater is not considered contact water, during construction all pit dewatering water (about 1,700 gpm or a total of 4,600 acre-feet) would be sent through an on-site water treatment plant (WTP) and discharged to Crooked Creek in accordance with APDES permitting requirements. During operations, roughly one-third of this amount on average (representing about 567 gpm) would be sent to the mill as a source of freshwater, and the rest would be treated and discharged. Average dewatering rate for the mine life is estimated at 1,600 gpm annually and the total volume pumped out during the operation period is estimated to be 56,100 acre-feet.

Contact Water Dams

Lower and upper Contact Water Dams (CWDs) would be constructed in American Creek with the objective of capturing any contact water runoff from the WRF, ore stockpiles, and water from horizontal drains that accumulates in the pit (Figure 2.3-6). Water stored in the ponds would be used to supply ore processing with water. While the ponds would not be lined and some seepage may occur, the seepage would drain to the pit and be managed with mine drainage.

The lower CWD would be constructed first to capture runoff from prestripped ground at the pit and the early phase of the WRF. Rock drains and Rob's Gulch diversion constructed in the footprint of the waste rock facility will collect and divert flow to the lower CWD. The upper CWD would be constructed during the first year of operations in order to provide additional storage capacity and operational flexibility for management of contact water. The WRF has been designed such that the lower CWD can store 405 acre-feet of contact water without inundating any of the waste rock placed in the WRF. As water storage volumes increase in the lower CWD, waste rock would be inundated. During operations, storage volumes in the lower CWD would not exceed 405 acre-feet more than 5 percent of the time to limit the amount of water in the lower CWD that inundates waste rock. When this capacity is reached, water would be pumped from the lower to upper CWD. Pipelines would take water from both CWDs to the process plant.

Freshwater Storage and Diversion

A number of structures would be built at the mine to manage non-contact fresh water; that is, water that would not come into direct contact with mining infrastructure. Examples include surface water flows or stormwater runoff diverted around mining infrastructure, as well as impounded fresh water.

A temporary freshwater diversion dam (FWDD) would be constructed and operational in the mid to upper reaches of American Creek in the first year of mine operations only, in order to minimize runoff into the lower CWD in the early stages of the WRF use. This would reduce the amount of contact water that would need to be managed. Excess fresh water that accumulates in this dam would be discharged to Omega Gulch which flows into Crooked Creek. Two temporary diversion dams, the North and South FWDDs, would be constructed upstream of the TSF in Anaconda Creek to minimize runoff to the impoundment and facilitate construction of the starter tailings dam. Water behind the FWDDs would be controlled by pumping to diversion channels around the north and south sides of the main impoundment area. The area disturbed by the FWDDs would eventually be incorporated into the WRF and TSF as they expand during operations.

Snow Gulch reservoir would be constructed in a tributary of Crooked Creek, located north of the mine (Figure 2.3-6), and provide a contingency source of fresh water during operations. In years with average or below-average precipitation, the CWDs and pit dewatering system would not be able to meet process plant water requirements, in which case additional water would be obtained from the Snow Gulch reservoir. Water from the dam would be pumped to the lower CWD before being sent to the process plant.

Diversion channels would be constructed around all stockpiles at the mine site to minimize contact water runoff and erosion. Runoff from overburden stockpiles would be directed to stormwater/sedimentation ponds prior to discharge to Crooked Creek or its tributaries.

Process Water Requirements

The ore processing plant would require a minimum of roughly 3,200 gpm of fresh water to operate, and about 17,500 gpm on average over the life of the mine, an amount that would vary annually depending on plant feed rates.

The priority for meeting ore processing water requirements would be to use reclaim water from the TSF first, followed by contact water pond and pit dewatering water, before using freshwater from the Snow Gulch reservoir. During operations, roughly 75 percent of the total process water needs would come from TSF reclaim water; on average, about 15 percent would come from the contact water ponds, and the remaining 10 percent would be made up of smaller volumes from the TSF seepage recovery system (SRS), pit dewatering water, and the Snow Gulch reservoir. During periods of low precipitation, more freshwater water from the reservoir would be used to meet the water needs of the process plant.

Reclaim water from the tailings pond would be pumped from a floating pump barge through a pipeline to ore processing. Table 2.3-4 summarizes the average water requirements for the mill.

Table 2.3-4: Estimated Processing Plant Water Use

Mill Water Source	Estimated Use (gpm)	Percent of Total
TSF reclaim water	13,703	78%
Contact water ponds	2,514	15%
TSF seepage	600	3%
Pit water	500	3%
Snow Gulch freshwater reservoir	154	1%
Total Plant Water Use:	17,471	100%

Notes:

gpm = gallons per minute

Source: SRK 2012b.

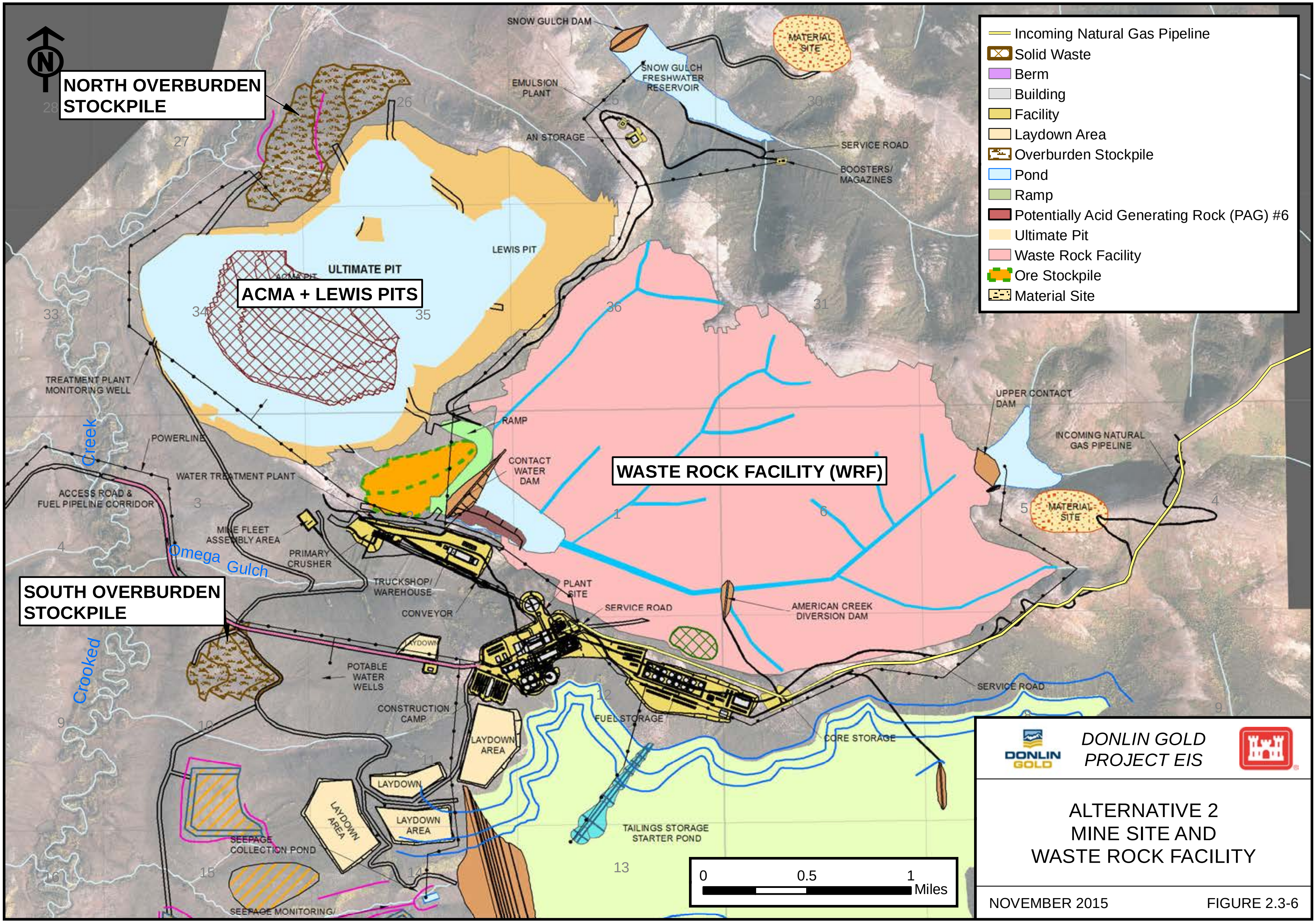
Other Water Uses

Ore processing consumes about 99 percent of the water needs at the mine site. Other uses such as dust control, fire protection, drinking water, truck wash, and sanitary needs comprise the remaining water requirements of the mine.

Potable water for the construction camp, permanent accommodations camp, and the plant site, would be obtained from eight freshwater wells that would be drilled south of Omega Gulch, near Crooked Creek. These wells would supply a volume of 70 gallons per person per day during construction and operation of the mine. The construction camp freshwater tank (80,000 gallons) and a similar freshwater storage tank, potable WTP, reserve storage tank, and distribution system would be provided for the permanent accommodations camp once mine operations commenced. The distribution piping to remote buildings would be through above-ground insulated and heat-traced HDPE pipes. Where possible, the potable water distribution pipes to other areas would be within the utility corridors to buildings.

Two sanitary treatment plants (STPs) would be constructed for the project; one for the construction camp and one for the permanent camp. Untreated sewage effluent would be piped or trucked to the STPs, and treated sewage effluent from the STPs would report to the TSF.

Firewater supply for the plant site would be pumped from the lower Contact Water Pond to a 475,500-gallon combined freshwater / firewater storage tank located near the plant site. Around half the water, or 264,000 gallons, contained in the tank would be dedicated to firewater storage. In addition, the freshwater storage tanks at the construction camp and permanent camps would include a 30,000-gallon reserve supply for fire protection.



ALTERNATIVE 2
MINE SITE AND
WASTE ROCK FACILITY

NOVEMBER 2015 FIGURE 2.3-6

2.3.2.1.8 MINE SITE – TAILINGS STORAGE FACILITY

The TSF is proposed to be built in the Anaconda Creek Valley immediately south of the WRF location. A general layout of the TSF is shown on Figure 2.3-7. The 2,351-acre facility would consist of a main, lined dam embankment; two temporary, lined, FWDDs; a fully-lined impoundment; a reclaim water system; and an SRS. Built in phases, the facility would have the capacity to store 568 million tons of tailings. Constructed in phases, the height of the tailings dam at completion would be 464 feet.

The tailings dam footprint would be excavated to bedrock, constructed using compacted rockfill, a prepared underlayer, and lined with a 60-mil (0.06-inch) linear low-density polyethylene (LLDPE) composite liner on the upstream face. The tailings impoundment footprint would be lined with a 60-mil (0.06-inch) textured LLDPE liner.

The FWDDs would limit the amount of fresh water entering the TSF during operations and provide control of the volume of water in the impoundment during the first three years of operation. Two FWDDs would be maintained during the first three years of TSF operation. At the end of the third year, the FWDDs would be decommissioned, their liners removed, and the areas regraded. During dam construction, the FWDDs would minimize runoff to the impoundment and facilitate construction of the facility's starter dam, and placement of the liner.

Runoff to the TSF would be controlled with staged diversion channels built on both sides of the facility, in addition to the two temporary upstream FWDDs. An SRS consisting of a pond, diversion ditches, and monitoring/ seepage collection wells would be constructed immediately downstream of the dam. During operations, water from the SRS would be used as process water, pumped back into the impoundment, or treated and discharged.

2.3.2.1.9 MINE SITE – WASTE ROCK FACILITY AND ORE/OVERBURDEN STOCKPILES

An estimated volume of 3 billion tons of waste rock would be excavated from the pit with 2.46 billion tons placed in the WRF. The WRF would be immediately east of the pit in the American Creek Valley. A general layout of the 2,240-acre WRF and overburden stockpile is shown on Figure 2.3-6.

Drainage control would be provided in the WRF foundation using engineered rock drains in the valley bottom, with connecting secondary rock (finger) drains constructed in the smaller contributing drainages. These upstream water collection and diversion measures would be constructed prior to mine production. The WRF would be unlined.

As discussed in Section 2.3.2.1.7, the lower CWD would be constructed in the American Creek Valley downstream of the WRF and would capture runoff from the WRF. The surface and groundwater flow direction in American Creek between the lower CWD and ACMA Pit would be toward the ore stockpile and pit dewatering wells. Surface and groundwater from this area would be pumped back to the lower CWD and would be managed as mine contact water. The upper CWD would also be constructed to capture surface water before the WRF.

Waste rock to be removed from the mine pits has been characterized using samples obtained during exploration and factoring in potential for acid generation as well as for leaching metals (SRK 2012e). Waste rock was characterized as either PAG or NAG, and has been assigned to reactivity categories (see Section 3.7.2.4). Categories 1 to 4 are considered NAG, and categories 5 to 7 are PAG. Approximately 91 percent of the waste rock has been characterized as NAG (see Table 2.3-5).

Table 2.3-5: Waste Rock Characteristics and Estimated Tons

Waste Rock Classification	Description	Estimated kTons[1]	Percent of Total
Overburden	Non-acid generating	46,432	1.52%
NAG	Non-acid generating (categories 1 to 4)	2,776,721	91.10%
PAG 5	Potentially acid generating after several decades	87,114	2.86%
PAG 6	Potentially acid generating in less than one decade	135,064	4.43%
PAG 7	Potentially acid generating in a few years	2,555	0.08%
Total		3,047,886	100%

Notes:
1 kTons = thousands of tons
Source: SRK 2012e.

Based on the waste rock's characterization as either PAG or NAG, it would be placed in one of three areas:

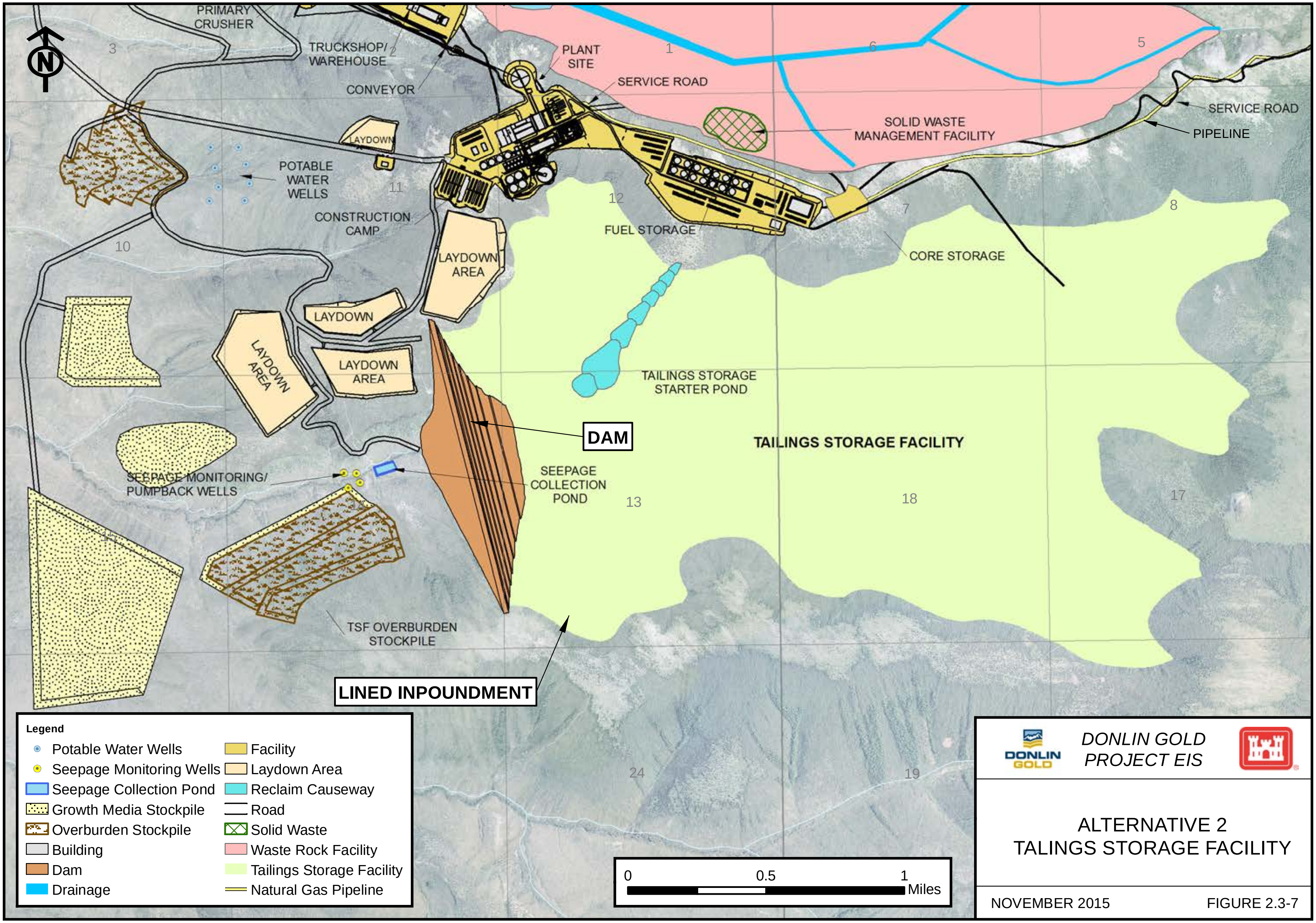
- American Creek drainage WRF,
- ACMA pit backfill, or
- Anaconda Creek drainage TSF dam.

Table 2.3-6 summarizes disposition of waste rock in each area.

Table 2.3-6: Waste Rock Placement and Estimated Tons

Waste Rock Placement	Description	Estimated kTons	Percent of Total
American Creek drainage WRF	NAG	2,252,501	73.9%
	PAG 5	70,587	2.3%
	PAG 6 (In Isolated Cells)	123,320	4.0%
	Overburden	46,387	1.5%
ACMA pit backfill	Overburden	45	0.0%
	NAG	429,091	14.1%
	PAG 5	11,833	0.4%
	PAG 6	11,744	0.4%
	PAG 7 (2,508 Kton Temporarily Stockpiled at WRF Until ACMA Pit is Completed)	2,555	0.1%
Anaconda Creek drainage TSF (Construction)	NAG	95,129	3.1%
	PAG 5	4,694	0.2%
Total		3,047,886	100%

Notes:
1 kTons = thousands of tons
Source: SRK 2012e.



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ALTERNATIVE 2
TALINGS STORAGE FACILITY

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FIGURE 2.3-7

Some NAG would be used as construction material for haul roads and the TSF. NAG waste rock would also be dumped around the PAG waste rock to isolate the PAG from the exposed final surface of the WRF and to neutralize runoff from the PAG.

The Proposed Action would place waste rock from both pits in the WRF, located east of the pit area. The first lift of the WRF would begin during mine construction and most lifts would be about 100 feet thick. Lifts would be placed so that the finished surface has an approximate 3-to-1 slope (18 degrees). The WRF would have a maximum height of 1,150 feet and store, at completion, 2.46 billion tons of waste rock.

Waste rock classified as PAG 5 would usually be mixed with surrounding NAG waste rock and dispersed on the WRF to produce a well-mixed blend. To further mitigate the potential for PAG 5 to generate acid, the last 80 feet of the dump crest advancement of any lift would be limited to only NAG 1-4 waste rock. This would ensure the final regraded slopes of the WRF would consist of NAG 1-4 waste rock with an average thickness of about 30 feet. Mine engineers would develop a PAG/NAG boundary beyond which only NAG waste rock can be placed. This would ensure no PAG 5 material is placed beyond the PAG/NAG boundary and the regraded final slopes of the WRF would consist entirely of NAG material.

During the early years of operation, approximately 123.32 million tons of PAG 6 would be placed in permanent, isolated cells in the Rob's Gulch and Unnamed Gulch sections of the WRF. PAG 6 waste rock placed in the WRF would be isolated to reduce contact with water and minimize the potential to become acidic. PAG 6 rock in Rob's Gulch and Unnamed Gulch would be placed in cells over a foundation of NAG waste rock. The NAG foundation material would act as a rock drain to convey the runoff and perennial flows out of this drainage and limit its contact with the PAG 6 waste rock. Each PAG 6 cell would be covered with a low permeability cap to minimize infiltration of surface water.

Also during the early years of operation, approximately 2.5 million tons of PAG 7 would be segregated from the other waste rock material types and placed on a low-grade ore stockpile area for temporary storage at the toe of the WRF, near the center of American Creek Valley. Once the ACMA Pit final limits are reached at approximately Year 22 of mine operation, the PAG 7 material stored in the low-grade stockpile would be relocated to the bottom of the ACMA Pit. At this point, all PAG 6 and PAG 7 mined in the Lewis Pit would also be placed in the ACMA Pit backfill, and no additional waste rock would be placed in the low-grade stockpile or isolated cells in the WRF.

NAG waste rock would be used in the construction of the TSF as fill, filter media, riprap, and material for the underdrains. Only NAG waste rock would be used for portions of the TSF that would not be within lined containment areas. Approximately 5 million tons of PAG 5 waste rock would be used for the construction of the TSF, but would only be placed in the portions of the TSF within lined containment (e.g., reclaim causeway).

During initial construction of the WRF, organic materials would be stripped and stored for use as growth medium during reclamation. Overburden materials removed from the foundation of the WRF would either be placed in temporary overburden stockpiles or mixed with waste rock. Overburden stockpiles would be located north and south of the open pits (Figure 2.3-6). The North Overburden Stockpile would primarily contain fine grained materials, consisting of organics (woody debris and peat), and unconsolidated sediments. The boundary of the stockpile would be bermed to channel stormwater runoff to a settling pond for sediment control prior to any discharge. The South Overburden Stockpile would be located immediately south of Omega Gulch and contain coarse-grained materials, primarily gravels and colluvium. The boundary of the South Overburden Stockpile would be bermed. Storm and seepage water would be collected and pumped to the lower Contact Water Pond.

2.3.2.1.10 MINE SITE – POWER, UTILITIES, SERVICES AND INFRASTRUCTURE

The total power planned generating capacity to be installed for the mine site and permanent accommodation camp is 227 megawatts (MW) which includes redundancy. The average running load is designed to be 153 MW (see Table 2.3-7). Electric grinding mill motors at the ore processing plant would use most of the power generated.

The Angyaruaq (Jungjuk) Port site would have a stand-alone power generation facility with two 600 kilowatt (kW) generators (one primary and one backup), fueled by ultra-low sulfur diesel. The airstrip would rely on two 200 kW generators (one primary and one backup) to run pumps and lights and would also be fueled by ultra-low sulfur diesel.

Table 2.3-7: Summary of Mine Site Components Power Use

Mine Site Power	Power Use
Total connected load	227 megawatts (MW)
Engines	12 natural gas fueled combined-cycle engines with heat recovery and steam cogeneration
Emergency power	1 generator
Average running load	153 MW
Average natural gas consumption	11.2 billion standard cubic feet (BSCF) per year
Angyaruaq (Jungjuk) Port site generators	2 x 600 kW, one primary, one standby
Airstrip generators	2 x 200 kW, one primary, one standby

Source: SRK 2012a.

Power Plant and Transmission Lines

Electric power would be generated for the mine site by a dual-fueled (natural gas and diesel) multi-engine power plant with a steam turbine utilizing waste heat recovery from the engines. The location of the power plant is shown on Figure 2.3-1. The primary source of fuel for the power plant would be natural gas transferred via a 315-mile long pipeline (see Section 2.3.2.3) although diesel could also be used as a backup fuel. The power plant would contain 12 reciprocating engines divided into two independent halves by a blast wall and a single steam turbine. During an emergency situation, half of the power plant's reciprocating engines could operate as needed to meet the essential power needs at the mine site.

Power from the plant would be distributed to the main process areas of the mine by power cables and overhead transmission lines. Overhead power lines would run to the more remote areas of the mine site, such as the primary crusher, the water system, pumping stations, tailings, and pit dewatering sites. Power to the permanent accommodations camp would be provided from the mine/process plant via a pole line. An emergency diesel generator would be installed at the camp to provide power in the event of pole line failure.

Fuel Storage and Distribution

The total diesel fuel storage capacity at the mine site would be 37.5 million gallons (Mgal). Mine site fuel storage tanks would be designed to contain a 10-month supply plus 1 month of contingency for the mine fleet. Fuel would be stored in 15 fuel tanks, each with a capacity of 2.5 Mgal. The fuel storage facility would be HDPE-lined and bermed to provide secondary containment. A Facility Response Plan (FRP), Spill Prevention, Control, and Countermeasure Plan (SPCC), and Oil Discharge Prevention and Contingency Plan would be developed and available onsite, as required by state and federal requirements.

Camp Buildings and Facilities

The permanent accommodations camp would be located at a different location than the construction camp, along the mine access road approximately 2.4 miles from the mine site. It would initially house 434 workers and be expanded to house a maximum of 638 workers during mine operations. The camp would include six, 3-story dormitory wings and a single-story core services facility. Dormitory wings would be attached to the core services building via heated utility tunnels.

Solid Waste Management and Disposal

Solid waste would be reused, recycled or returned to the vendor as appropriate and feasible. The following materials would be reused, recycled, or returned to the vendor:

- antifreeze (ethylene and propylene glycol) – recycled and reused on site whenever possible
- mill liners – returned to vendor or shipped off-site for recycling as scrap metal
- hazardous batteries – returned to vendor for recycling or reclaimed off-site
- hazardous lamps – recycled off-site
- compressed gas cylinders – returned to vendor for reuse or recycled as scrap metal
- pallets – reused, incinerated and/or recycled off–site
- reagent containers – returned to vendor for reuse
- reusable parts – sold/reused on site or off-site where possible
- returnable/recyclable drums – returned to vendor for reuse and/or recycled as scrap metal
- scrap metal – recycled off-site (except for steel, which contains a small percentage of carbon)
- reusable light vehicle tires – returned to vendor for recycling
- used oil – burned for energy recovery in space heaters and process boilers on site (or shipped off-site for recycling when not possible to burn for energy recovery on site)
- other recyclables such as aluminum cans or plastic water bottles – recycled off–site

Solid waste management facilities at the proposed Donlin Gold Project would include inert solid waste landfills, the TSF and the WRF. These key waste management areas would be regulated by ADEC under a waste management permit.

Solid waste landfills would be constructed at the mine site and possibly at Angyaruaq (Jungjuk) Port, for the disposal of inert, non-hazardous solid waste. These landfills would be permitted by the ADEC in accordance with 18 Alaska Administrative Code (AAC) 60. The landfills at the mine site would be constructed as trenches within the WRF in an area covering approximately 16 acres. At the Angyaruaq (Jungjuk) Port facility, a small, inert landfill may be constructed within the port facilities, if needed.

Landfills would be designed and operated to keep runoff from outside the landfill area separate from the solid wastes and in such a way as to prevent the attraction of wildlife. Waste would be stored in suitable containers prior to incineration and/or disposal in the landfills. The surface surrounding the open landfill trenches would be graded to prevent precipitation from ponding or draining into the trench. A light cover of approximately 6 inches of soil or rock would be placed as needed over debris that can be windblown. Windblown litter and littered refuse from the areas around the landfill would be collected and returned to the landfill for disposal. An intermediate cover of approximately 12 inches would be applied to portions of the landfill that are inactive for 90 days or more. Once a landfill trench is filled to within 4 feet of the surface, it would be covered with a layer of rock. By the nature of the WRF construction, another layer of rock, a minimum 20 feet thick, would be placed over the filled trenches when the next lift is placed on the WRF. The additional cover would minimize the chance of water percolating through the rock material and into the refuse trench. Landfill trenches closed during final reclamation would have a minimum of 24 inches of cover material placed, as required by ADEC.

Inert, general mine refuse (e.g., packaging, non-recyclable empty containers, non-putrescible refuse) would be placed directly into permitted on-site landfill trenches in a designated section of the WRF. During construction, solid waste that contains organic matter (e.g. wooden pallets, paper, cardboard, and wood scraps) may be incinerated in a burn pit or incinerator. Residues from the incinerator or burn pit would be disposed of in the landfill. Unusable, small vehicle tires that cannot be returned to the vendor would be disposed of in the landfill. All large loader and truck tires would be buried in a designated area at the WRF.

Waste Water Management and Disposal

Two STPs would be installed at the mine site: one at the permanent accommodations camp and one at the construction camp. The construction camp STP would be reconfigured and reduced in size after construction is completed to receive sanitary flows from the process facilities during operation. Domestic wastewater from facilities would be pumped to the STPs via insulated pipelines. STPs would process domestic wastewater and produce treated effluent and filtered sludge, which would be burned in an on-site incinerator. Treated effluent from both plants would be discharged to the TSF after secondary treatment in accordance with ADEC permitting requirements. A septic tank and leach field would be installed at Angyaruaq (Jungjuk) Port, resulting in no additional effluent to the STPs.

In addition to the STPs, a WTP with a footprint of approximately 0.5 acres would be constructed near the southern end of the ACMA and Lewis pits, north of the primary crusher. The WTP would treat water from the pit dewatering wells and other excess water prior to discharge to

Crooked Creek (see Section 2.3.2.1.7). A year before overburden stripping activities begin, seventeen ACMA and Lewis pit dewatering wells would be installed. The pumping of these wells would begin 6 months prior to the commencement of overburden stripping operations.

During mine operation additional wells would be installed and some wells would be decommissioned as the pit expanded. Over the mine life a total of 35 pit-perimeter wells and 80 in-pit wells would be installed. Groundwater pumped from these wells would be used in the process or treated at the WTP.

Stormwater would be managed at the mine site during construction, operations, and closure, reclamation, and monitoring. Surface water flows, stormwater runoff diverted around mining infrastructure, and impounded fresh water would be managed as non-contact water if it did not contact mine infrastructure or mined material. Other than settling ponds and other Best Management Practices (BMPs) to control turbidity/sediment, non-contact water would be directly discharged to surface water without treatment beyond settling. The flows from the American Creek freshwater diversion dam and from the TSF temporary FWDDs and diversions would be managed as non-contact water.

Hazardous Waste and Materials Management

Hazardous materials, such as explosives, sodium cyanide, and mercury require special handling, storage and disposal at appropriate facilities to meet regulatory requirements. In Alaska, hazardous wastes are regulated by the U.S. Environmental Protection Agency (EPA), Region 10, in accordance with RCRA. The site would have no permanent on-site hazardous waste management and all hazardous waste would be shipped off-site for permanent disposal. Donlin Gold is not proposing to operate the site as a Hazardous Waste Treatment, Storage, and Disposal Facility under RCRA.

Explosives

Explosives would need to be used at the mine site (see Section 2.3.2.1.2 regarding blasting). Explosives would be stored and handled according to the MSHA regulations contained in 30 CFR Part 56. Separate storage bins would be used for emulsion, ammonium nitrate, and fuel oil. All detonators would be stored in an explosives magazine meeting applicable federal and state safety requirements. Charges and detonators would be shipped separately under the control of the explosives supplier.

Sodium Cyanide

Sodium cyanide handling and storage procedures would be in accordance with International Cyanide Management Code (ICMC), and with all applicable state and federal regulations. The ICMC is a voluntary practice established to augment existing regulatory requirements. Cyanide would be transported according to 49 CFR Parts 171-180. Specific methods proposed for the handling of sodium cyanide include:

- Sodium cyanide would be shipped from the manufacturer to the mine site on barges as solid briquettes in 22-ton International Standards Organization (ISO) approved type 2 watertight sparge tank-tainers. The cylindrical tank-tainers would be permanently and prominently marked with appropriate warning labels and hazard markings.

- A secure storage area with secondary containment would be constructed at the mine site for the containers. An enclosed structure would be provided for storage of cyanide.
- The Angyaruaq (Jungjuk) Port would have a reserved secure and isolated cyanide container storage area, which would include secondary containment.
- All marine carriers, transportation personnel, and ore processing staff involved in the handling of sodium cyanide would be trained in safe handling and spill response procedures.
- Personal protective equipment would be onboard each tug towing sodium cyanide, at each port where the product would be stored, and with each truck that would transport the containers from the Angyaruaq (Jungjuk) Port site to the mine site. Cyanide detoxification chemicals would be available.
- Any carrier of sodium cyanide would be required to have a contract with a certified and licensed hazardous materials response and cleanup company, located within Alaska.

Mercury

Mercury and mercury-containing materials would be managed in accordance with a Donlin Gold Mercury Management Plan that is currently under development. In general, Donlin Gold would collect elemental mercury and spent carbon into specialized containers, and store in centralized, separate, enclosed facilities. Weekly inspections would be conducted at the accumulation and storage areas (Donlin Gold 2014d).

Elemental mercury captured in the retort furnace and scrubbers during mineral processing would be managed as co-product and shipped off-site to an appropriate facility as a hazardous material. Additionally, mercury-loaded carbon from the mercury abatement process would be shipped off-site using barges to a regulated facility for permanent storage. All mercury would be transported in specially marked mercury containers that would be managed in accordance with the mercury management plan. In addition, a mercury suppressant would be used to reduce the soluble mercury levels leached into solution from the autoclave process to low levels within the reclaim water stream recycled from the TSF.

2.3.2.1.11 MINE SITE – ENVIRONMENTAL AND SAFETY

Prior to the start of mine construction, an Environmental Management System (EMS) consisting of management and maintenance plans based on permits and authorization requirements would be developed. The EMS would describe the environmental engineering standards (e.g., secondary containment for petroleum products, process solutions, and reagents), operations requirements, maintenance protocols, and emergency response actions. BMPs and safety procedures would be followed for maintenance activities during mine operation.

The proposed project would comply with the statutes governing spill prevention and emergency response including: the CWA, Section 311; Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Section 103; Emergency Planning and Community-Right-to-Know Act of 1986; Title III of the Superfund Amendments and Reauthorization Act, Section 304; and ADEC requirements under 18 AAC 75 for spill prevention and contingency planning. The SPCC plan describes the system that would be used for the prevention, response, containment, safe cleanup, and reporting of spills or discharges of substances that could potentially degrade the environment.

Construction, operation, and reclamation activities at the mine would operate in conformance with all MSHA safety regulations (30 CFR, Parts 1-199). In addition, Donlin Gold would require that all visitors, vendors, and contractors comply with all applicable safety and health standards. On-site mine rescue and medical emergencies would be handled by a Mine Rescue Team. The team would include advanced first aid and emergency medical technician trained personnel. Medical evacuation would be available by fixed-wing aircraft or helicopter to fly injured workers to medical facilities.

All structures would be designed in compliance with State of Alaska Building Codes and approved by the State Fire Marshal's office. All heavy equipment would be equipped with automatic and/or manually activated fire suppression systems, and handheld extinguishers would be installed in all heavy equipment and small vehicles. Automatic sprinklers would be installed in buildings, and where appropriate, fire extinguishers would be mounted on the walls of all buildings.

2.3.2.1.12 MINE SITE – CLOSURE, RECLAMATION, AND MONITORING

The overall purpose of reclamation would be to stabilize disturbed areas and return them to vegetated conditions to ensure long-term protection of land and water resources in the area and to obtain near-natural conditions. During operations, concurrent reclamation would be performed whenever possible in areas that are no longer required for active mining. After completion of reclamation of the site in accordance with an approved reclamation plan, the site would be monitored for a period of years as required by ADEC and the Alaska Department of Natural Resources (ADNR) to ensure successful implementation of the reclamation plan and to protect water quality, the environment, and human health and safety.

Donlin Gold would also update and complete a Closure Social Impact Assessment 3 years prior to closure of any operation (SRK 2012a). The Closure Social Impact Assessment would focus on identifying the social risks and impacts to the region from mine closure and would be followed by development of mitigation plans to address these risks and impacts. The ADNR requires the Reclamation and Closure Plan to be revised every 5 years. Revisions would address any changes in the design, construction, operations, and concurrent stabilization and reclamation of the facility (SRK 2012a).

<u>Reclamation of Pits and Tailings Storage Facility</u>

The reclamation and closure of the mine falls under the jurisdiction of ADNR, Division of Mining, Land, and Water; the ADEC; and the Corps. The Alaska Reclamation Act (Alaska Statute [AS] 27.19) is administered by the ADNR. The Act applies to state, federal, municipal, and private land and water subject to mining operations. Surface water and groundwater monitoring of mine facilities would continue during closure and post-closure. The monitoring would remain in place, depending on compliance history, up to or beyond 30 years – until each specific facility is physically and chemically stabilized.

Open Pit Reclamation

Mining in the ACMA Pit is expected to be complete in Year 22 of mine operations. When ACMA Pit mining is complete, waste rock from the Lewis Pit would be placed there instead of hauling it to the WRF. PAG 7 waste rock from the temporary stockpiles would be placed into either of the completed pits. This back fill would result in a pit lake with a design depth of 1,023.5 feet.

Upon final mine closure, the haul roads in and around the open pit would be smoothed of all berms except those necessary for erosion control and public safety. The open pit would gradually fill over the next 50-55 years with groundwater recharge, water from surface runoff, and water pumped from the TSF. It is predicted that the surface water of the pit lake would not meet APDES permit limits and would require treatment before discharge into Crooked Creek. Five years prior to the pit returning to a level that would result in discharges to the environment (e.g., loss of hydrologic sink), a post-closure WTP would be constructed and treatment would begin 2 to 3 years before the pit is full, when the water would be about 33 feet below the spillway crest. Pumping would eventually be required in perpetuity to ensure pit water lake levels do not overtop the banks of the pit lake. A generator would be installed to run the WTP and pump, and fuel would be flown or barged in as necessary. Sludge produced by the post-closure WTP would be sent to the bottom of the pit lake for final storage. To ensure adequate funding for potential perpetual water treatment, a Post-Reclamation and Closure Maintenance Trust Fund would be established during construction and operations to cover the costs of the WTP operations and maintenance, as well as post-closure monitoring.

Tailings Storage Facility Reclamation

Four years of reclamation activities would occur at the TSF. In the first year of reclamation, TSF water would be pumped back into the ACMA Pit, which would become the initial pit lake. During the remaining 3 years, one-third of the tailings surface would be progressively reclaimed each year. Pumping to the pit lake would continue, when required, to prevent a large pond from redeveloping within the TSF. Runoff from the cover between Years 5 and 43 after mining operations end would be collected in a LLDPE-lined pond at the southeast corner of the reclaimed TSF. Runoff water would be tested to ensure it meets applicable water quality standards prior to discharge. If standards are not met, it would continue to be pumped to the pit lake.

During the closure and post-closure periods, seepage from the TSF would be monitored for quality. In the event this seepage does not meet AWQS, it would be pumped to the pit lake. The seepage collection pond would be decommissioned when it can be demonstrated that the water meets AWQS for discharge to Anaconda Creek (see Section 2.3.2.3.7, Monitoring Activities, for additional information regarding monitoring).

Waste Rock Facility Reclamation

The WRF would be progressively reclaimed during mining operations by placing a cover designed to minimize infiltration and support vegetation growth. The cover would consist of a 12-inch layer of colluvium or terrace gravel and a top layer of 14 inches of peat and loess. Before the cover layers were added, the underlying waste rock would be contoured to provide natural drainage toward the southern margin of the WRF. The contouring would also produce a drainage pattern of swales to minimize erosion and protect the cover integrity. Runoff and seepage from the reclaimed WRF would be pumped to the pit lake.

Buildings and Equipment Sites Reclamation

As the mine site is closed and decommissioned, materials, equipment, and buildings would be removed. Equipment, buildings, and piping not needed for the reclamation and post-closure monitoring activities would be reutilized at another mine site, sold or salvaged, or disposed of in an approved manner. Remaining structures at the site would be reduced to rubble and disposed of in a manner approved by the ADEC, potentially including burial on-site. Building foundations would be broken up to prevent them from being an impermeable impediment to natural percolation of precipitation. Following equipment and structure removal, sites would be graded lightly for proper drainage, ripped and scarified, seeded, and mulched if necessary.

At large sites such as the mill, crusher, shop, and fuel storage areas, once internal structures and foundations have been appropriately demolished, removed, or buried, these areas would be graded to blend with the surrounding topography. The areas would then be ripped to mitigate the compaction effects of traffic and infrastructure. Following ripping, each site would be evaluated to determine if the addition of native soil material is needed for vegetation to establish. A thickness of approximately 3.3 feet of cover colluvium would be established over any buried debris to ensure it remains subsurface into the foreseeable future.

Mine site components that are in direct contact with process reagents would be rinsed with fresh water during decommissioning. This process water would be collected and treated at the WTP.

Fuel use during closure activities would be carefully monitored to ensure minimal excess fuel at completion. Any fuel that remains would be removed from the mine site.

Electrical Power Facilities

When the electrical power demand no longer requires an operational power plant, the power plant, substations, overhead power lines, and associated facilities would be removed from the site, unless it is agreed upon by the land owner to keep them. The power plant and the generators would be removed from the site or demolished and buried on-site, in keeping with regulatory requirements. As stated above, a generator would be installed to power the WTP and pump, and fuel would be flown or barged in as necessary.

Mobile Equipment and Vehicles

Mobile equipment and vehicles that cannot be reused would be buried in the WRF at closure. To prevent degradation of water resources or other contaminant mobilization, all fluids would be drained and batteries removed from all mobile vehicles prior to burial. The equipment would then be covered under reclaimed dump faces during regrading activities. The equipment burial locations would be surveyed and reported to the ADEC in the final closure report for the site.

Roads and Airstrip Reclamation

Reclamation would be the same for all mine roads within the mine site. Onsite roads not required for long-term monitoring would be ripped, as necessary, to eliminate the effects of compaction, re-contoured to blend with the surrounding topography, covered with a layer of growth media, and reseeded to meet the applicable reclamation standards. Berms, side-cast material, and road drainage ditches would be reclaimed in this process. Blacktop road and parking surfaces would be ripped and buried in place in road ditches and depressions prior to re-grading. Culverts would be removed, natural drainage areas restored or stabilized, and roadbeds would be graded where necessary to provide adequate drainage. Water bars to divert run-on and run-off, and control erosion and berms to restrict human access, would be incorporated where necessary and as approved by ADNR. Reclamation of these features would include development of a streambank stabilization protocol.

The airstrip and the 30-mile road connecting the mine site to the Angyaruaq (Jungjuk) Port would remain to be used in monitoring during mine reclamation into the foreseeable future. These facilities would not be reclaimed until monitoring of the mine site is completed.

Post-Mining Land Use

The post-mining land use for the mine site after reclamation and closure would be wildlife habitat and recreation as prescribed by the Reclamation Standards (AS 27.19.020).

2.3.2.2 ALTERNATIVE 2 – TRANSPORTATION FACILITIES

Alternative 2 would include shipping cargo from marine terminals in Seattle and Vancouver via ocean barges up the Kuskokwim River to a cargo terminal in Bethel. At Bethel, cargo would be transferred from ocean barges to river barges for towing up the Kuskokwim River to the upriver Angyaruaq (Jungjuk) Port site. Cargo would be transported by truck from the port to the mine site.

Transportation facilities include:

- Consolidation of annual consumables and other general cargoes in Seattle and Vancouver operated by third parties or marine transport companies. Forward deployment of construction and general cargoes to Dutch Harbor or Juneau prior to the start of the shipping season on the Kuskokwim River.
- A cargo terminal in Bethel with three general cargo berths (one for ocean barges and two for river barges), a 950-foot long berth face, a 200-foot wide concrete ramp for roll-on / roll-off cargo handling, and a 16-acre storage yard.
- The 21-acre upriver Angyaruaq (Jungjuk) Port site including a 700- to 800-foot long wharf, a pocket berth for barges, a ramp to the pocket berth, container handling equipment, seasonal storage for containers and break-bulk cargo, barge season office / lunchroom facilities, and a truck shop.
- A 30-mile long, gravel two-lane road from the port site to the mine site.
- A 5,000-foot long by 150-foot wide gravel airstrip capable of supporting DeHavilland Dash 8 and Hercules C-130 aircraft. The airstrip would be located approximately nine miles west of the mine site and accessed by a three mile spur road beginning at mine access road mile 5.4.
- Construction would begin upon receipt of permits and would take approximately 1.5 years working year round.

Figure 2.3-8 provides an overview of the primary transportation facilities proposed for Alternative 2.

The following sections provide an overview of the new and existing infrastructure that would be used to transport cargo and fuel to the mine site, and transport materials for the natural gas pipeline.

All facilities would be operated according to applicable laws and regulations to ensure the security of the facilities, protection of the environment, and safe storage, handling and transportation of hazardous materials.

2.3.2.2.1 TRANSPORTATION FACILITIES – EXPECTED OCEAN AND RIVER TRAFFIC

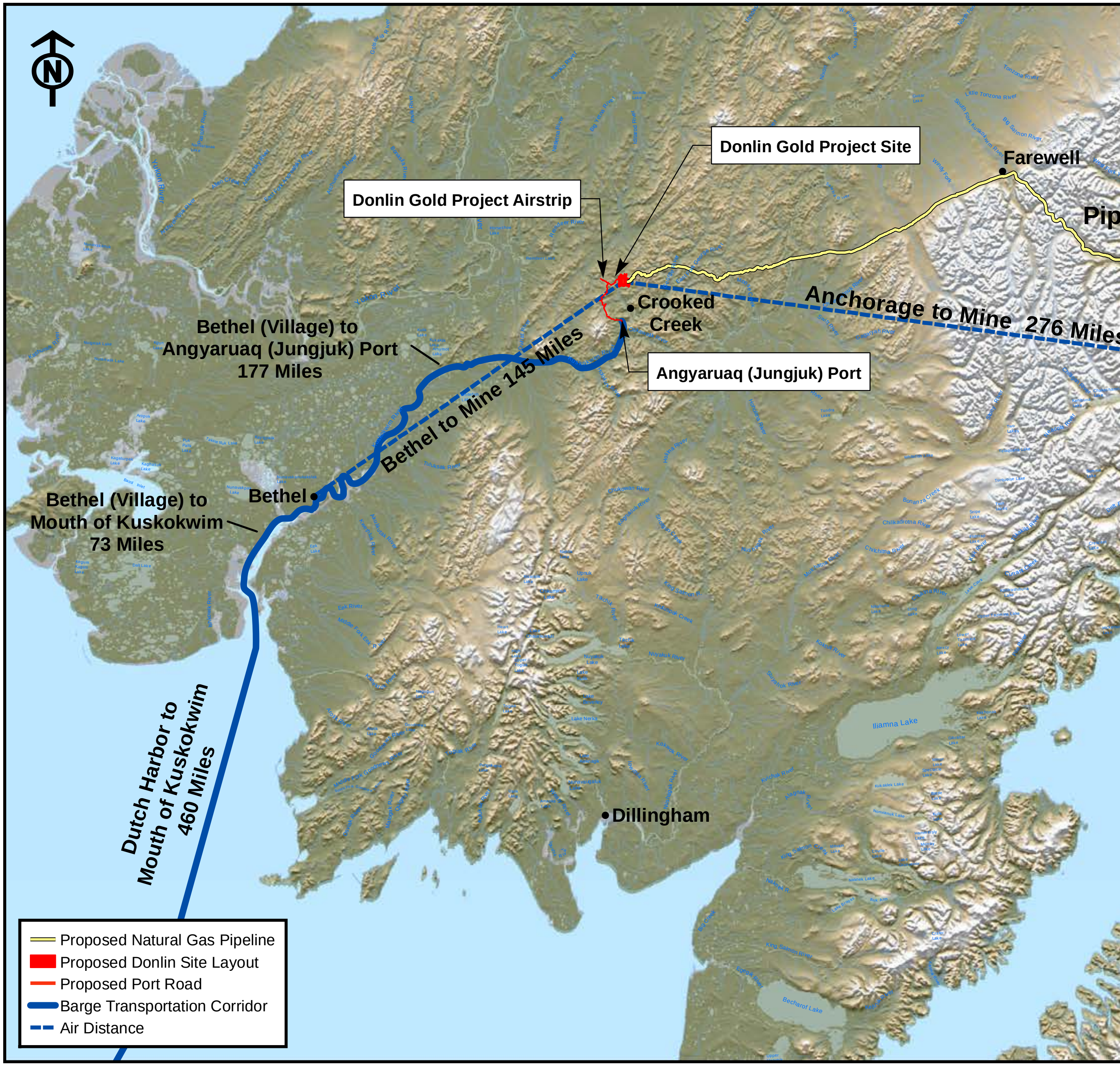
The transportation plan has been designed for an annual volume of 115,000 short tons of cargo during operation of the mine. The cargo would be shipped from Pacific Northwest (Seattle, WA and Vancouver, BC) ports via ocean barges towed by ocean-going tugs to Bethel. Each ocean barge would be 360 feet long by 100 feet wide and would have a net cargo capacity of 10,040 tons at a maximum draft of 16 feet. Three sets of tugs and barges would make a total of 16 round-trips per year during construction and 12 round-trips per year during operation (Table 2.3-8). About 85 percent of all cargoes would be containerized; the remainder would be handled as break-bulk.

Before entering the navigation channels at the mouth of the Kuskokwim River, all vessels would take on a pilot who would remain on board until the vessel has berthed at Bethel. Pilots would also accompany vessels on the downstream transit. Ocean barges would require tug assistance while berthing and de-berthing.

Fully loaded ocean cargo barges may reach Bethel during higher river levels on a tide, however for most of the barging season a barge would need to discharge up to 3,580 tons of cargo, approximately one-third its load, at Oscarville Crossing (about 7 miles downriver from Bethel) to reduce its draft to 12 feet and permit it to transit the narrows and reach Bethel. Lightering would be accomplished by barge-to-barge transfer using a floating crane barge and would take about one day. Off-loaded cargoes would be transferred to river barges and then shipped directly to Angyaruaq (Jungjuk) Port, 199 river miles upstream from Bethel.

Fuel sourced from refineries in the Pacific Northwest would be transported to Dutch Harbor by two chartered 6.5-Mgal capacity, double-hull ocean barges making a total of seven round trips in a shipping season. In Dutch Harbor the fuel would be pumped ashore to storage tanks.

For delivery to Bethel, fuel would be transported by one double-hull, 2.94-Mgal capacity ocean fuel barge. These ocean barges would have a fully loaded draft of 14 feet, but could be loaded light during low-water conditions. As a result, these fuel barges would be able to go directly to Bethel without having to lighter to reduce draft to cross the narrows at Oscarville Crossing. The ocean barge would be towed by a 3,000 horsepower tug; there would be a total of 14 trips per year.



DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
TRANSPORTATION FACILITIES
OVERVIEW

NOVEMBER 2015

FIGURE 2.3-8

Table 2.3-8: Estimated Annual Ocean and River Barge Traffic

Barge	Transporting	From	To	Number of Round Trips per Season
Ocean	Cargo	Seattle, WA or Vancouver, B.C. area	Bethel	16 during construction 12 during operations
Ocean	Fuel	Seattle WA or Vancouver, B.C. area	Dutch Harbor	7
Ocean	Fuel	Dutch Harbor	Bethel	14
River	Pipe and Equipment	Bethel	Kuskokwim Landing	20 during first two years of pipeline construction
Ocean	Pipe and Equipment	Anchorage	Beluga Landing	20 during first year of pipeline construction
River	Cargo	Bethel	Angyaruaq (Jungjuk) Port Site	50 during construction[1] 64 during operations
River	Fuel	Bethel	Angyaruaq (Jungjuk) Port Site	19 during construction[2] 58 during operations

Notes:

1 Total would be 200 trips over four years. Exact distribution by year would be determined during final design.
2 Average: actual number would range from 9 to 29 annually.

Source: SRK 2013a.

River barges can move upstream of Bethel once the river is free of ice, generally between April 24th and June 1st. The Kuskokwim River typically begins to freeze up in early October ending the shipping season. The Kuskokwim River shipping season of 110 days is assumed to occur from June 1st to October 1st, allowing for two weeks of downtime to allow for occasional low flows. Between Bethel and Angyaruaq (Jungjuk) Port, available draft on the river is limited by the depth of water in the shallower sections of the river, such as the section of river alongside Nelson Island, just upstream of Tuluksak.

General cargo would be transported up the Kuskokwim River from Bethel to Angyaruaq (Jungjuk) Port via two river-barge cargo tows comprised of a single-hull pusher-tug and four river barges for a combined operating capacity of 3,477 short tons (Figure 2.3-9 illustrates a typical tug and 4-barge configuration). Each river cargo-barge would be 150 feet long by 44 feet wide with a maximum loaded draft of 7.5 feet (minimum operating draft of 3 feet). The river cargo barge fleet would operate 24 hours per day, 7 days per week during the shipping season. Two tows of four cargo barges each would make a total of 64 round trips per season, with a round trip travel time of 81 hours.

At Bethel, fuel would be transferred directly to river barges for transport to Angyaruaq (Jungjuk) Port, or off-loaded for temporary storage and later transport to Angyaruaq (Jungjuk) Port. Fuel would be transported up the Kuskokwim River from Bethel to Angyaruaq (Jungjuk) Port by a fleet of two pusher-type fuel tows comprising a tug and four double-hull river barges. A tow of four fuel barges would have a capacity of 1.29 Mgal. Each fuel barge would be 165 feet long by 44 feet wide with a maximum operating draft of 7 feet. The tugs would be triple-screw 1,450 horsepower with a minimum draft of 3 feet. The fuel barges would have round-trip cycle times between Bethel and Angyaruaq (Jungjuk) Port of 81 hours for a total of 58 trips per shipping season during the mine life.

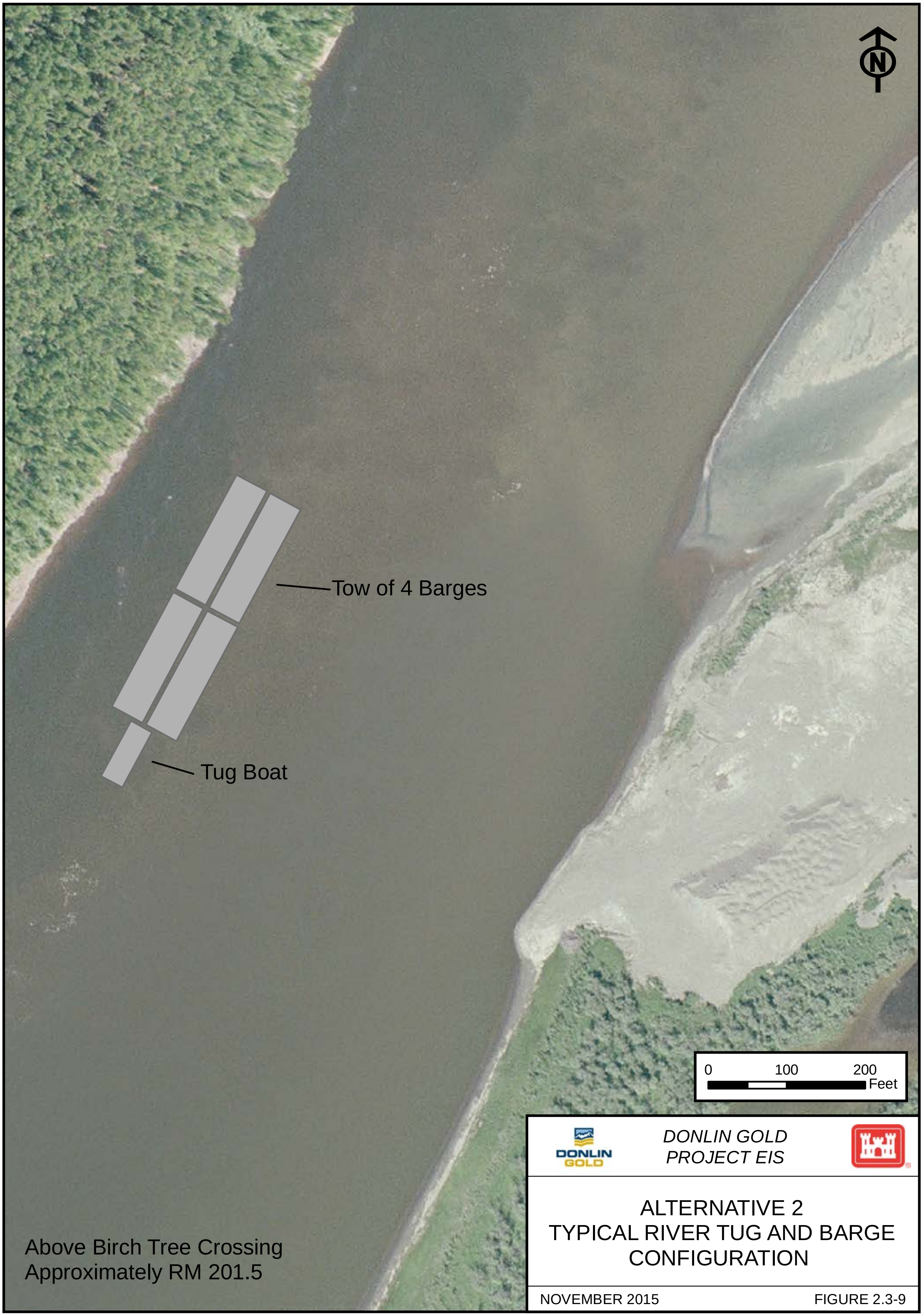
River data would be assessed at the beginning of each year to assist in the logistics of barging so that adjustments can be made to address any changing environmental conditions. A barge-loading plan for each trip would be based on expected river conditions and a forecast of the minimum available draft on the river for the duration of the trip between Bethel and Angyaruaq (Jungjuk) Port. An automated load planning system that constantly monitors river conditions in real time would be used to provide load planners with the information needed to load barges to maximum capacity, yet provide an adequate margin of safety against grounding.

Prior to the first barging season, the river would be surveyed and an electronic navigation chart developed. In addition, sections of the river where navigation is difficult or tight would be buoyed annually. A series of ranges providing line-of-site navigation would be constructed, and each tug would be equipped with modern communication and navigation equipment. Each tug-and-barge set would be equipped with a tracking transmitter to provide the traffic manager and terminal managers with the location of any vessel and its position in relation to the other fleet vessels at all times.

Unintentional grounding of a barge could occur if a barge captain strayed from the surveyed channel due to a navigational error. In this case, an empty tow traveling down the river would be available to assist the stranded barge, as needed. In the event of a stranding in the active channel, equipment would be mobilized from the lower port site, or elsewhere on the river, to assist as needed.

The steps that would be taken in the event of an unintentional grounding/stranding would be:

1. Notify the USCG.
2. Separate and secure any barges still floating to a secure location where they would not impede the flow of traffic on the river. Once this has been completed, the tug and crew would then focus on the stranded barge.
3. Check river conditions and determine if the water depths are rising, falling, or static. In the event of rising water conditions, the crew may elect to wait a short period to see if rising water floats the barge free.
4. If water depth is falling, or static, or the water is not rising fast enough, then the next step would be to attempt to pull the barge free using the available tug. This step would be dependent on the nature of the stranding and the river bed conditions. Additional tugs could be utilized to assist in pulling the barge as needed.
5. In the event that river bed conditions and/or other factors preclude pulling the barge free, or the tug is unable to free the barge, the next step would be to obtain approval from USCG to lighter fuel or cargo to empty barges. Lightering would be conducted by bringing an empty fuel barge (equipped with a pump for fuel transfer) or cargo barge (equipped with a crane or other equipment for transferring cargo), as appropriate, alongside the stranded barge and transferring fuel or cargo across to the empty barge until the stranded barge is refloated. All appropriate spill containment measures (booms, etc.) would be implemented prior to lightering any fuel.



DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
TYPICAL RIVER TUG AND BARGE CONFIGURATION

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FIGURE 2.3-9

6. Once enough cargo had been removed from the barge it would refloat. In extreme cases the empty barge could be pulled free using a tug. As these barges would be designed for storage on the river bank during the winter season when the river is frozen, the barges would be structurally strong enough to withstand being pulled free. Freed barges would be inspected by appropriate qualified personnel as required by the USCG and repaired, as needed, before being placed back into service.

2.3.2.2.2 TRANSPORTATION FACILITIES – DUTCH HARBOR

Dutch Harbor is an international, year-round port, directly on the shipping routes between the West Coast and other countries on the Pacific Rim. With well-developed port infrastructure, sufficient available land, and well established national and international shipping connections, existing facilities at Dutch Harbor would be used as a location for forward deployment of cargo prior to the shipping season on the Kuskokwim to store containers and break-bulk cargo. Other forward deployment locations could include existing facilities in Juneau, Kodiak, and King Cove if the need arises and space is available. Additionally, fuel would be stored in Dutch Harbor for transfer to Bethel. Total fuel storage capacity at Dutch Harbor is currently approximately 12 Mgal. Additional fuel storage capacity of approximately 8 Mgal may be needed for the project which may require development of 4 to 6 acres of land. Undeveloped land adjacent to existing industrial areas appears to be available throughout Unalaska.

Donlin Gold does not propose the construction of additional capacity in Dutch Harbor. Donlin Gold has indicated they would likely use a third-party to transport fuel and other supplies to the project site. That party would determine what amount of additional fuel capacity, if any, would be required in Alaska to accommodate demand. That party would also be responsible for applying for and obtaining any permits that may be required for the expansion. Although it is not certain additional capacity would be needed, this potential third party expansion is treated as a connected action and the potential effects are analyzed in this EIS.

2.3.2.2.3 TRANSPORTATION FACILITIES – BETHEL CARGO TERMINAL

The Port of Bethel is the main port facility for the Yukon-Kuskokwim Delta. A 16-acre cargo terminal would likely need to be constructed in Bethel to receive barges originating from the marine terminals in Seattle, Vancouver, and Dutch Harbor (forward deployment), and barges returning from the upriver port at Angyaruaq (Jungjuk). The cargo terminal would be an expansion of the existing Knik Bethel Yard Dock and would have three general cargo berths, one for ocean barges and two for river barges, and a roll-on/roll-off berth. The terminal will have enough space to store up to 2,750 containers. General cargo would be placed into temporary storage or transferred directly to river barges for transport upriver. The new terminal would provide storage for five ocean barge loads. In addition, 3.5 acres would be required for buildings, access roads, equipment storage, plowed snow, spare pallets, chains, ropes, damaged containers, lighting, dock surface, and equipment maneuvering. Figure 2.3-10 shows the proposed Bethel Cargo Terminal location. Donlin Gold has indicated that a third-party would construct and operate the Bethel Cargo Terminal. That party would determine what amount of additional storage space and waterfront structures, if any, would be required to accommodate demand. That party would also likely be responsible for applying for and obtaining any permits that may be required for the expansion. Since this work by a third party would be a connected action for the proposed Donlin Gold Project, the environmental effects are evaluated in this EIS as indirect effects.

2.3.2.2.4 TRANSPORTATION FACILITIES – BETHEL FUEL TERMINAL AND TANK FARM

Donlin Gold anticipates a 6 Mgal fuel storage facility may be needed at Bethel. The tanks would be installed in lined containment areas. When ocean fuel barges arrive at Bethel, the fuel would be offloaded into storage, or directly to river barges alongside the ocean barge. Donlin Gold has indicated they would likely use a third-party to construct and operate the Bethel Fuel Terminal. That party would determine what amount of additional storage space and waterfront structures, if any, would be required to accommodate demand. That party would also likely be responsible for applying for and obtaining any permits that may be required for the expansion. Since this work by a third party would be a connected action for the proposed Donlin Gold Project, the environmental effects must be evaluated as indirect effects.

2.3.2.2.5 TRANSPORTATION FACILITIES – ANGYARUAQ (JUNGJUK) PORT SITE

The proposed 21-acre Angyaruaq (Jungjuk) Port Site would be the upriver terminus for barges and a transfer point for cargo going to the mine site. Containers, fuel, and cargo would be off-loaded and then trucked to the mine during the 110-day annual barging season. Proposed facilities include two river barge berths, a roll-on/roll-off berth, and a container storage area with sufficient space to hold up to 1,000 containers (Figure 2.3-11). The port would have container handling equipment, seasonal storage for containers, break-bulk cargo, fuel, and office facilities. The barge landing would be powered by two 600 kW diesel generators. Empty containers would be returned to Bethel and then to marine terminals in Seattle or Vancouver.

2.3.2.2.6 TRANSPORTATION FACILITIES – MINE ACCESS ROAD

A new 30-mile access road between the Angyaruaq (Jungjuk) Port and the mine site would be used to transport fuel and cargo (Figure 2.3-12). The access road would be a 2-lane, 30-foot wide, all-season gravel road used for mine support traffic. No public use would be authorized.

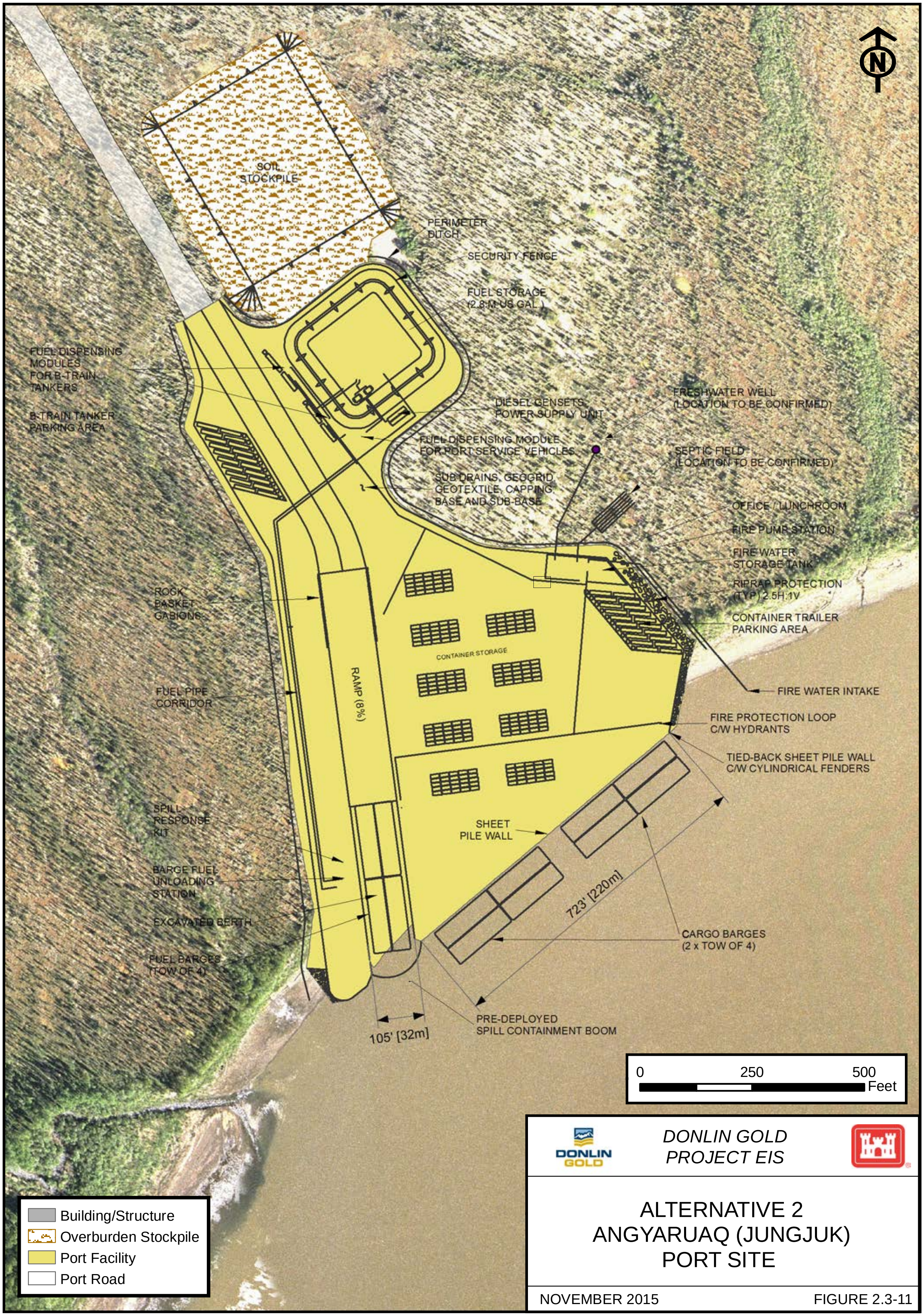
Construction materials would be excavated from borrow material sites (MS) along the mine access road, listed in Table 2.3-9. Material from these sites would also be used for construction and maintenance of access and spur roads. Spur roads off of the main access road would run to the proposed airstrip and permanent camp facilities.

DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
BETHEL CARGO TERMINAL,
FUEL TERMINAL, AND TANK FARM

NOVEMBER 2015

FIGURE 2.3-10



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ALTERNATIVE 2
ANGYARUAQ (JUNGJUK)
PORT SITE

NOVEMBER 2015

FIGURE 2.3-11

DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
ANGYARUAQ (JUNGJUK) PORT
MINE ACCESS ROAD

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FIGURE 2.3-12

Table 2.3-9: Material Sites – Angyaruaq (Jungjuk) Road

Material Site	MP nearest Angyaruaq (Jungjuk) Road	Area (acres)	Material Type	Volume (m^3)
MS 01	25.3	49.1	Granodiorite	1,000,000
MS 02	23.3	22.2	Sedimentary rock	300,000
MS 03	21.8	16.9	Sedimentary rock	100,000
MS 04	19.6	11.2	Sedimentary rock	80,000
MS 05	18.4	24.8	Rhyolite	200,000
MS 06	17.1	3.6	Rhyolite	50,000
MS 07	14.9	22.0	Rhyolite	50,000
MS 08	0	26.2	Granodiorite	300,000
MS 09	12.8	5.1	Rhyolite	50,000
MS 10	10.4-11.0	205.4	Gravel	1,500,000
MS 12	7.2	15.0	Basalt	200,000
MS 13	5.4	81.1	Basalt	350,000
MS 16	2	29.5	Sedimentary Rock	250,000
Total	N/A	512.1	N/A	4,430,000

Notes:

m^3 = cubic meters
MP = milepost
MS = material site

Source: Recon 2011c.

There would be two water sources for dust control for the mine access road, listed below.

- South Fork Getmuna Creek. The project would draw 80 acre feet per year at an extraction rate of 100 gpm. Withdrawal would occur from May through October, during construction, operations, and closure. The stream is anadromous.
- Kuskokwim River. The project would draw 637 acre feet per year at an extraction rate of 800 gpm. Withdrawal would occur from May through October, during construction, operations, and closure. The river is anadromous.

Fifty-one stream or drainage crossings have been identified along the road route, of which six would require bridging (see Table 2.3-10).

Table 2.3-10: Angyaruaq (Jungjuk) Road Stream Crossings

Stream Name	MP	Crossing Type
Crooked Creek Floodway #1	0.1	culvert
Crooked Creek Floodway #2	0.1	culvert
Crooked Creek	0.2	bridge
Crooked Creek Floodway #3	0.2	culvert

Table 2.3-10: Angyaruaq (Jungjuk) Road Stream Crossings

Stream Name	MP	Crossing Type
Crooked Creek Floodway #4	0.3	culvert
Unnamed	9.1	culvert
Unnamed	9.3	culvert
Unnamed	9.5	culvert
Unnamed	13.2	culvert
Unnamed	13.4	culvert
Unnamed	13.6	culvert
Unnamed	13.9	culvert
Two Bull Creek	14.5	culvert
Unnamed	14.9	culvert
North Fork Getmuna Creek Floodway #1	16.1	culvert
North Fork Getmuna Creek Floodway #2	16.1	culvert
North Fork Getmuna Creek	16.1	bridge
South Fork Getmuna Creek Floodway #1	17.1	culvert
South Fork Getmuna Creek Floodway #2	17.1	culvert
South Fork Getmuna Creek	17.2	bridge
Getmuna Creek Tributary	17.5	bridge
Unnamed	19.5	culvert
Unnamed	19.5	culvert
Unnamed	19.9	culvert
Unnamed	20.1	culvert
Unnamed	20.2	culvert
Unnamed	20.3	culvert
Unnamed	20.4	culvert
Unnamed	20.4	culvert
Unnamed	20.5	culvert
Unnamed	20.8	culvert
Unnamed	20.9	culvert
Unnamed	21.3	culvert
Unnamed	21.4	culvert
Unnamed	21.5	culvert
Unnamed	21.7	culvert
Unnamed	21.8	culvert
Unnamed	22.1	culvert

Table 2.3-10: Angyaruaq (Jungjuk) Road Stream Crossings

Stream Name	MP	Crossing Type
Unnamed	22.5	culvert
Unnamed	23.0	culvert
Jungjuk Creek, Upper Crossing	24.1	bridge
Unnamed	24.5	culvert
Unnamed	24.5	culvert
Jungjuk Creek, Lower Crossing	24.8	bridge
Unnamed	24.9	culvert
Unnamed	25.2	culvert
Unnamed	25.9	culvert
Unnamed	26.0	culvert
Unnamed	26.2	culvert
Unnamed	26.8	culvert
Unnamed	26.9	culvert

Abbreviations:
MP = milepost
Source: Recon 2011b.

With an average round-trip time of 3.25 hours, the mine access road traffic would consist of fuel and cargo trucks operating during the approximately 110-day shipping season. On average, a cargo or fuel truck would arrive about every half hour either at the mine site or at Angyaruaq (Jungjuk) Port during a 12-hour shift (see Table 2.3-11).

Table 2.3-11: Estimated Mine Access Road Traffic

Vehicle	Transporting	Number of Vehicles	Number of Trips per Day	Number of Trips per Season
13,500-gallon capacity B-train tanker trucks	Fuel	10	27	2,963
10 tractor units	Cargo	10	27	2,917
Total		20	54	5,880

Source: SRK 2013a.

2.3.2.2.7 TRANSPORTATION FACILITIES – AIRSTRIP

The proposed airstrip would be a 5,000-foot by 150-foot gravel runway on a ridge approximately 9 miles west of the mine site (Figure 2.3-13). The aircrafts specified for the design of the airstrip are the DeHavilland Dash 8 and the Hercules C-130. The 3-mile airstrip spur road would begin at Mile 5.4 of the mine access road. Material for the airstrip would likely come from MS 10 along the mine access road. The mine site airstrip apron would have two 9,900-

gallon fuel storage tanks containing Jet Fuel (A) and one 5,000-gallon fuel tank containing 100 low lead aviation gasoline. A 9,900-gallon diesel tank would store fuel for two 200-kW generators to provide power to the airstrip facilities. All tanks would have secondary containment. See Table 2.3-12 for estimated flight frequency.

Table 2.3-12: Estimates of Annual Airport Operations at Mine Airstrip

Phase	Rotary Wing Aircraft	Fixed Wing Aircraft			
		Dash 8 Q300	Twin Otter Series 400	Cargo Plane (TBD)	Total Annual Operations[1]
Construction	TBD – local use in area of mine site development	2,808 (27 flights per week: 3 passenger flights per day, 6 cargo flights per week)	2,190 (3 flights per day)	156 (3 flights per 2 weeks)	5,154
Operations	TBD – casual use	936 (9 flights per week: 1 passenger flight per day, 2 cargo flights per week)	730 (1 flight per day)	52 (1 flight per 2 weeks)	1,718

Notes:

1 Arrivals and departures are counted separately. Operations = total number of arrivals and departures

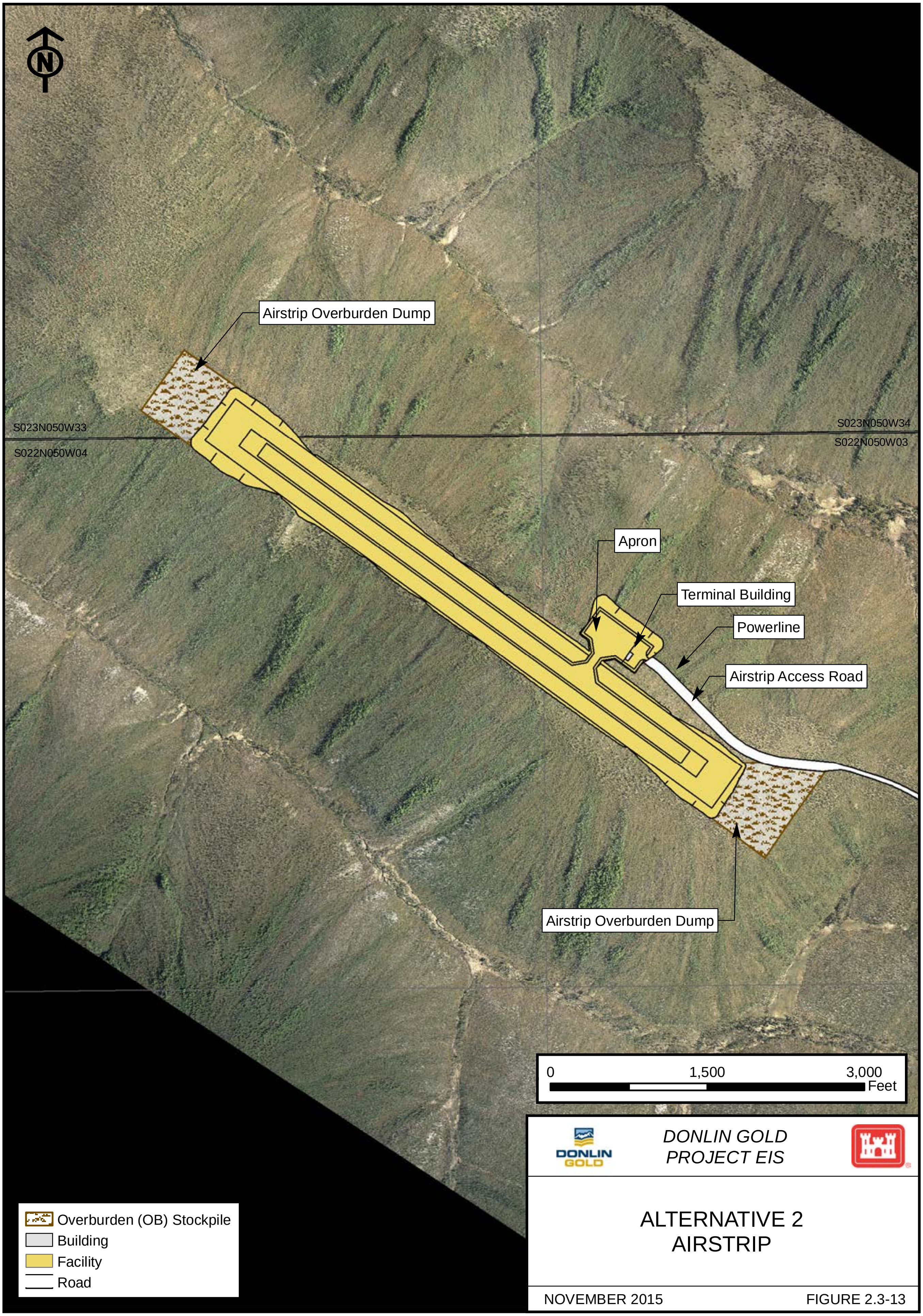
Source: Fernandez 2013e.

2.3.2.2.8 TRANSPORTATION FACILITIES – SHIPPING REQUIREMENTS AND SPILL RESPONSE

Under the Proposed Action, Donlin Gold would require compliance with the statutes governing customs, shipping of dangerous goods, and spill prevention and emergency response. These statutes include the Jones Act; International Marine Dangerous Goods Code; Oil Pollution Act; CWA, Section 311; CERCLA, Section 103; Emergency Planning and Community-Right-to-Know Act of 1986; or Title III of the Superfund Amendments and Reauthorization Act, Section 304; and ADEC requirements under 18 AAC 75 for oil spill prevention and contingency planning. The project spill plans describe the systems that would be used for the prevention, response, containment, safe cleanup, and reporting of spills or discharges of substances that potentially may degrade the environment.

The marine fuel carrier would be required to be certified under the International Safety Management Code, the American Waterways Operators Responsible Carriers Program, or both, and be a member of the Alaska Chadux Corporation (Chadux), a member-funded oil spill response organization headquartered in Anchorage. Chadux is classified as an Oil Spill Removal Organization by the USCG and registered as a Primary Response Action Contractor and a Non-tank Vessel Cleanup Contractor with the State of Alaska.

The agencies governing spill response include the ADEC, USCG, EPA, and USDOT PHMSA. Table 2.3-13 lists the oil spill response plans required for the Donlin Gold Project, the areas where they would apply and the agency with jurisdiction over the plans. In addition to oil spill response, the project would require the use, storage, transport, and disposal of other hazardous substances, which require specific environmental management plans.



DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
AIRSTRIP

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FIGURE 2.3-13

Table 2.3-13: Oil Spill Response Plans

Plan	Application	Jurisdiction	Reference
Marine Transportation Facility Response Plan	Bethel tank farm Angyaruaq (Jungjuk) Port fuel storage/transfer facility	USCG	33 CFR Part 154
SPCC Facility Response Plan	Containers of oil/fuel ≥ 55 gallons Bethel tank farm/fuel transfer facility Angyaruaq (Jungjuk) Port fuel storage/transfer facility Mine site oil/fuel storage	EPA	40 CFR Part 112
Vessel and Barge Oil Spill Response Plan	Vessels and barges	USCG	33 CFR Part 155
State of Alaska Oil Discharge Prevention and Contingency Plan	Bethel fuel storage/transfer facility Angyaruaq (Jungjuk) Port fuel storage/transfer facility Facility piping Vessels and barges Mine site oil/fuel storage	ADEC	18 AAC Chapter 75

Source: SLR 2012a.

The Donlin Gold Vessel Operations Oil Discharge Prevention and Contingency Plan (SLR 2012b) was prepared for vessels carrying petroleum products from or to any waterways associated with the Donlin Gold mining project. Donlin Gold developed the document to guide oil spill prevention and response activities in the event or threat of a discharge originating from a vessel in waters of Western Alaska. The Plan describes oil spill prevention and response activities and procedures for the Donlin Gold mine project and its primary response action contractor.

2.3.2.2.9 TRANSPORTATION FACILITIES – CLOSURE, RECLAMATION, AND MONITORING

Along with the removal and reclamation of all mine support facilities previously described, Angyaruaq (Jungjuk) Port would be partially reclaimed at the end of mine site operation. Sheet piles would be removed and the area around the barge landing would be recontoured. A barge landing and the 30-mile mine access road and airstrip would be maintained for delivery of WTP reagents, equipment, fuel, and supplies, as well as to provide access to the project site for long-term monitoring and operating the pit lake water treatment plant.

2.3.2.3 ALTERNATIVE 2 – NATURAL GAS PIPELINE

Donlin Gold proposes to construct a 14-inch-diameter steel pipeline to transport natural gas approximately 315 miles from an existing 20-inch gas pipeline tie-in near Beluga, Alaska, to the mine site power plant. The pipeline would require one compressor station at Milepost (MP) 0.4. At the mine site, natural gas would be used primarily as a fuel source for generating electricity and for space heating. Except for two above-ground fault crossings, each approximately 1,300 feet long, the pipeline would be buried within a ROW of 51-foot width on BLM-managed lands and 50-foot width elsewhere. Horizontal Directional Drilling (HDD) and winter trenching are among the techniques proposed to bury the pipeline at stream and river crossings. The gas pipeline would be operated near seasonal ambient ground temperature to minimize thermal disturbance to the surrounding soils permafrost. Approximately 20 mainline block valves (MLV) would be installed at not more than 20-mile intervals along the pipeline ROW, and a maintenance station would be located near the halfway point at Farewell (MP 153.6) (SRK 2013b). (Mainline valves close during a pipeline leak to minimize loss of contents.) An overview of the gas pipeline route is shown on Figure 2.3-14.

The pipeline would be designed to deliver up to 73 million standard cubic feet per day (MMscfd) of natural gas, at a maximum allowable operating pressure (MAOP) of 1,480 pounds per square inch gauge (psig) for 30 years. Electrical power for the compressor station at MP 0.4 would be supplied by a 25-kilovolt (kV) transmission line running north from the Beluga Power Plant to the metering station for approximately 7.7 miles, then the short distance of approximately 0.4 miles northwest to the gas compressor station at MP 0.4 (see Section 2.3.2.3.3). The transmission line and a fiber optic cable would be carried on electric transmission supports to the metering module located at the start of the pipeline as shown on Figure 2.3-15. The remainder of the fiber optic cable would be installed underground, except at the two above-ground fault crossings (see Section 2.3.2.3.2 for details on the fiber optic cable and installation).

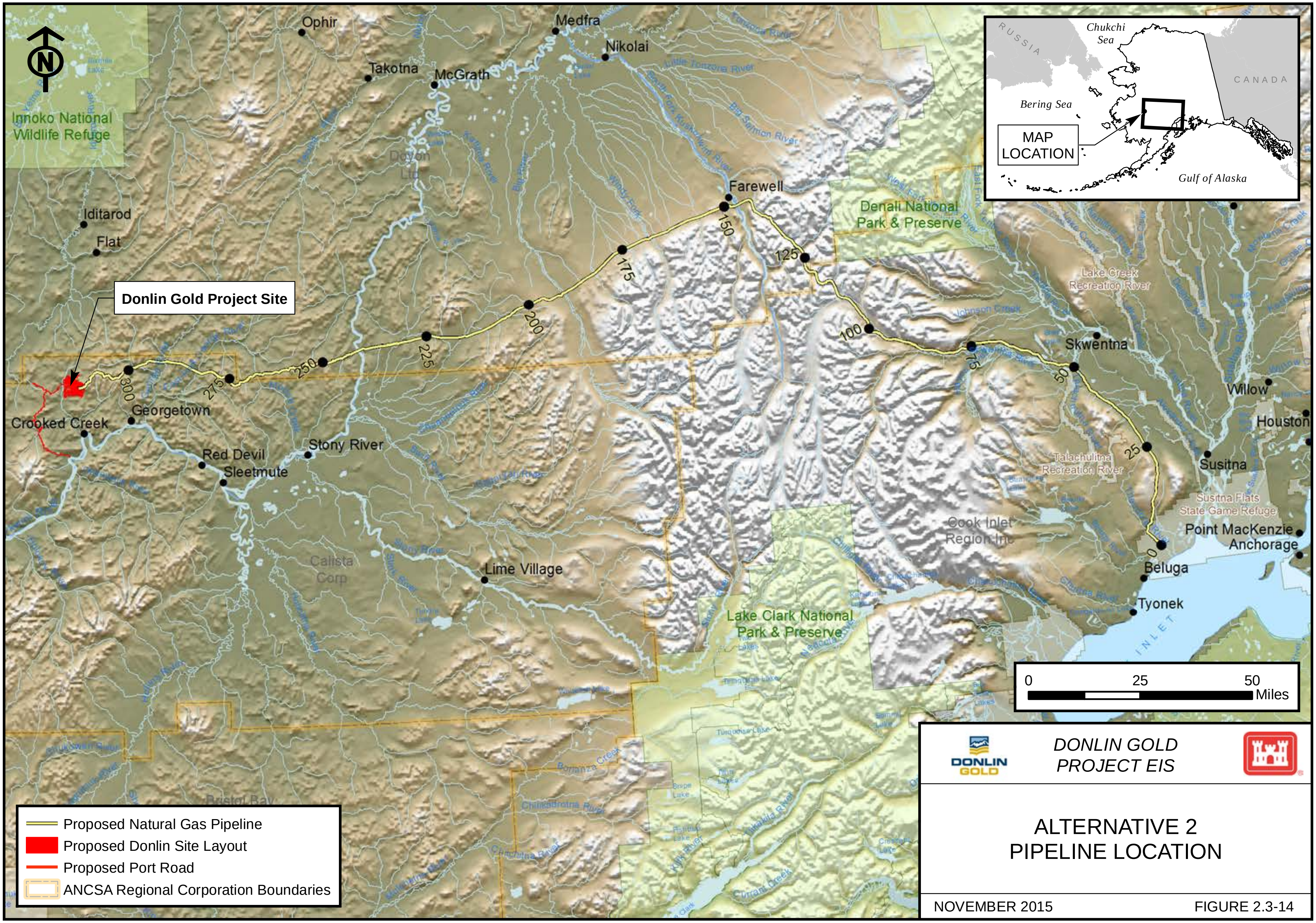
2.3.2.3.1 PIPELINE – RIGHT-OF-WAY

The 14-inch-diameter steel natural gas pipeline would connect to an existing 20-inch gas pipeline near the west side of the Beluga Gas Field, approximately 30 miles northwest of Anchorage as shown on Figure 2.3-14. The pipeline would be buried within the ROW, except at the Castle Mountain and the Denali-Farewell faults.

Pipeline Right-of-Way Corridor

Donlin Gold has identified a construction planning corridor of 300 feet, within which they would apply for a long-term ROW (50 feet wide on ANCSA and State of Alaska lands and 51 feet, 2 inches on BLM-managed lands) and an additional 100 feet wide construction corridor. The total nominal construction corridor would be 150 feet to install the pipeline and fiber optic cable. Figure 2.3-16 shows the planned evolution of the ROW. The 300-foot corridor would provide flexibility to adjust the pipeline alignment during construction to avoid sensitive resources, areas with steep slopes, marshes and bogs, river crossings, and permafrost terrain to the extent practicable.

Estimated total acreage on federal, state, and ANCSA Corporation lands for the 300-foot planning corridor is 11,457 acres as shown in Table 2.3-14. Ancillary facilities such as airstrips, construction campsites, and storage yards for pipe and equipment would require 2,643 acres.



DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
PIPELINE LOCATION

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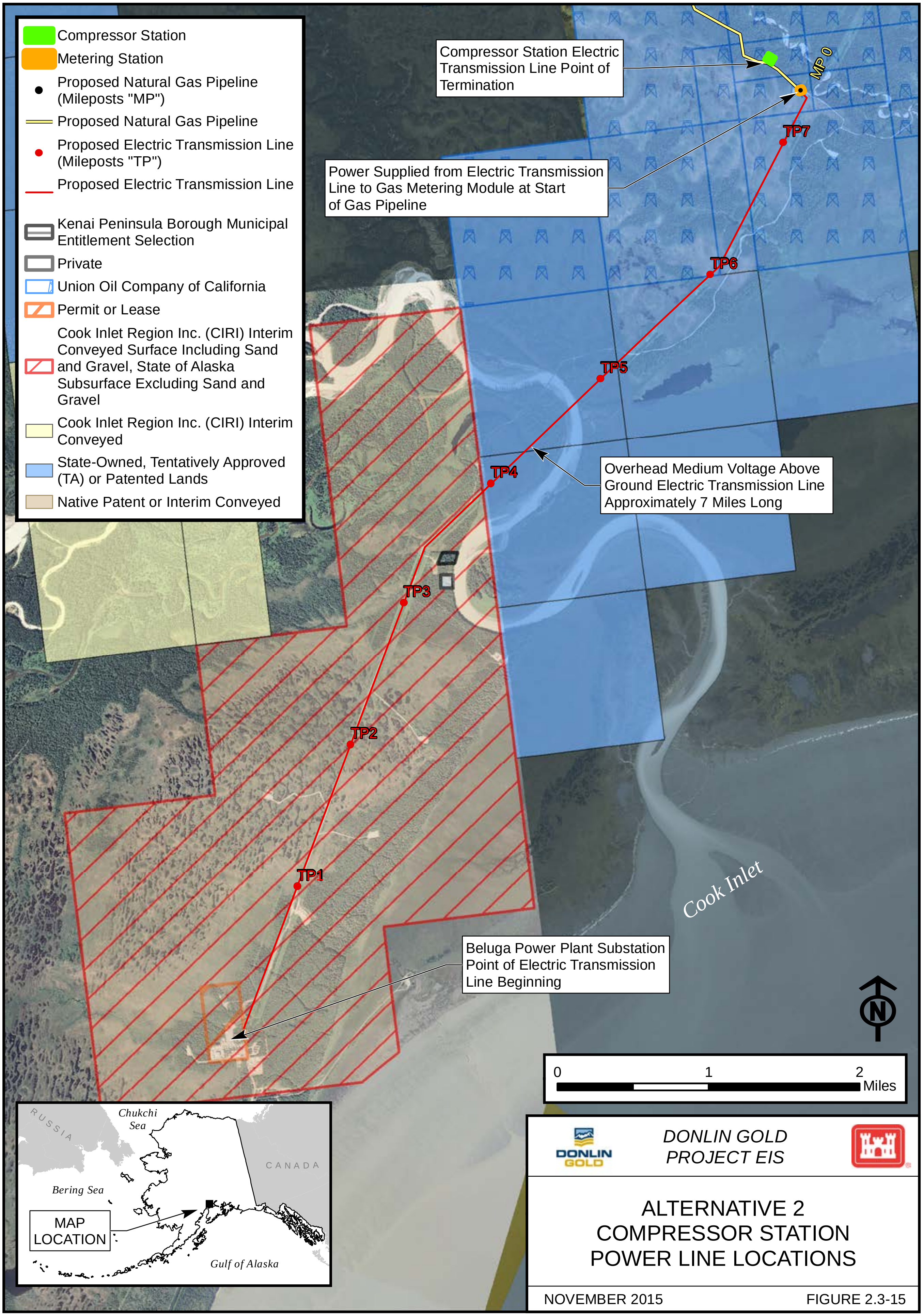
FIGURE 2.3-14



ALTERNATIVE 2 COMPRESSOR STATION POWER LINE LOCATIONS

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FIGURE 2.3-15

Table 2.3-14: Locations and Land Requirements for the Proposed Project

	Construction Planning Corridor and Ancillary Facilities (acres)		Approximate Length (miles)	Percentage of Total Length
	300-foot Planning Corridor	Ancillary Facilities*		
Pipeline				
Federal (BLM)	3,529	793	97	30.8%
State	7,504	1,713	206	65.4%
ANCSA Corporation	424	79	12	3.8%
Total	11,457	2,585	315	100%
Transmission Line				
State	NA	13	4	50%
ANCSA Corporation	NA	14	4	50%
Total		27	8	100%
Compressor Station				
	NA	1		
Total	11,457	2,643		

Notes:

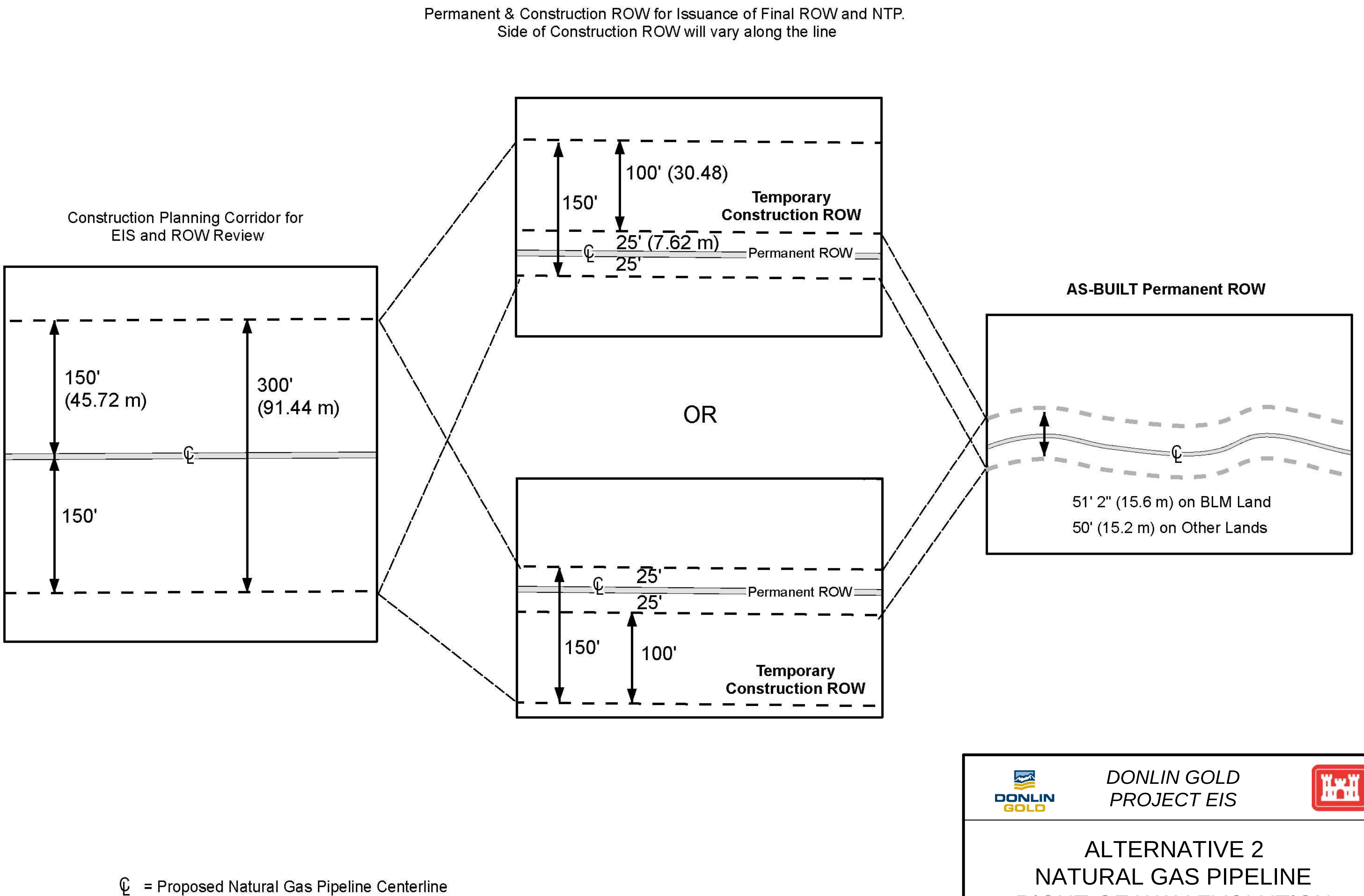
* These include access roads, laydown areas, airfields, borrow areas, and campsites.

Source: SRK 2013b.

In addition to securing ROW approvals from the State of Alaska and BLM, Donlin Gold would secure ROW easements from private landowners. All owners, tenants, and lessees of private land, and lessees and managers of public lands along the ROW would be notified in advance of construction activities that could affect their property, business, or operations. The pipeline ROW would not be an exclusive use ROW. Limitations on public use may be considered as mitigation but would need additional authorization and process by land management agencies.

The transmission line easement would be approximately 8 miles long and 30 feet wide for an estimated ROW area of about 28 acres (Figure 2.3-15). This includes the distance and acreage for the transmission line from the metering station at the start of the pipeline (MP 0) to the compressor station (MP 0.4).

ROW grants or leases would be necessary for the operation, maintenance, and decommissioning of the facilities. In addition, short-term ROWs would be required to accommodate construction activities, such as access roads and associated gates, material/equipment staging, geotechnical testing, and other short-term uses on those portions of the project on public land.



DONLIN GOLD
PROJECT EIS

ALTERNATIVE 2
NATURAL GAS PIPELINE
RIGHT-OF-WAY EVOLUTION

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FIGURE 2.3-16

2.3.2.3.2 PIPELINE – FIBER OPTIC CABLE

Donlin Gold is currently evaluating options for where the fiber optic cable would originate, including installation of a microwave tower, running a cable along existing power line routes from Anchorage, or from existing infrastructure at Beluga. If it originates at Beluga, an option is to run the fiber optic cable via the electric transmission line supports to the metering station at MP 0 (Figure 2.3-15). From the metering station, the fiber optic cable would be installed in the trench with the pipeline to the compressor station and then, except at the two fault crossings where the pipeline and cable would be above-ground, on to the mine site (within the proposed construction and operations ROW). Details regarding installation of the fiber optic cable would be completed during final design.

2.3.2.3.3 PIPELINE – ABOVE-GROUND FACILITIES

Above ground pipe and equipment would include: two approximately 1,300-foot, sections where the pipeline crosses the Castle Mountain and the Denali-Farewell faults; metering stations at the start and end of the pipeline; the pigging receiver and launcher near Farewell; the compressor station near MP 0.4; and above-ground piping and associated valves at the 16 remote MLVs located at no more than 20-mile intervals.

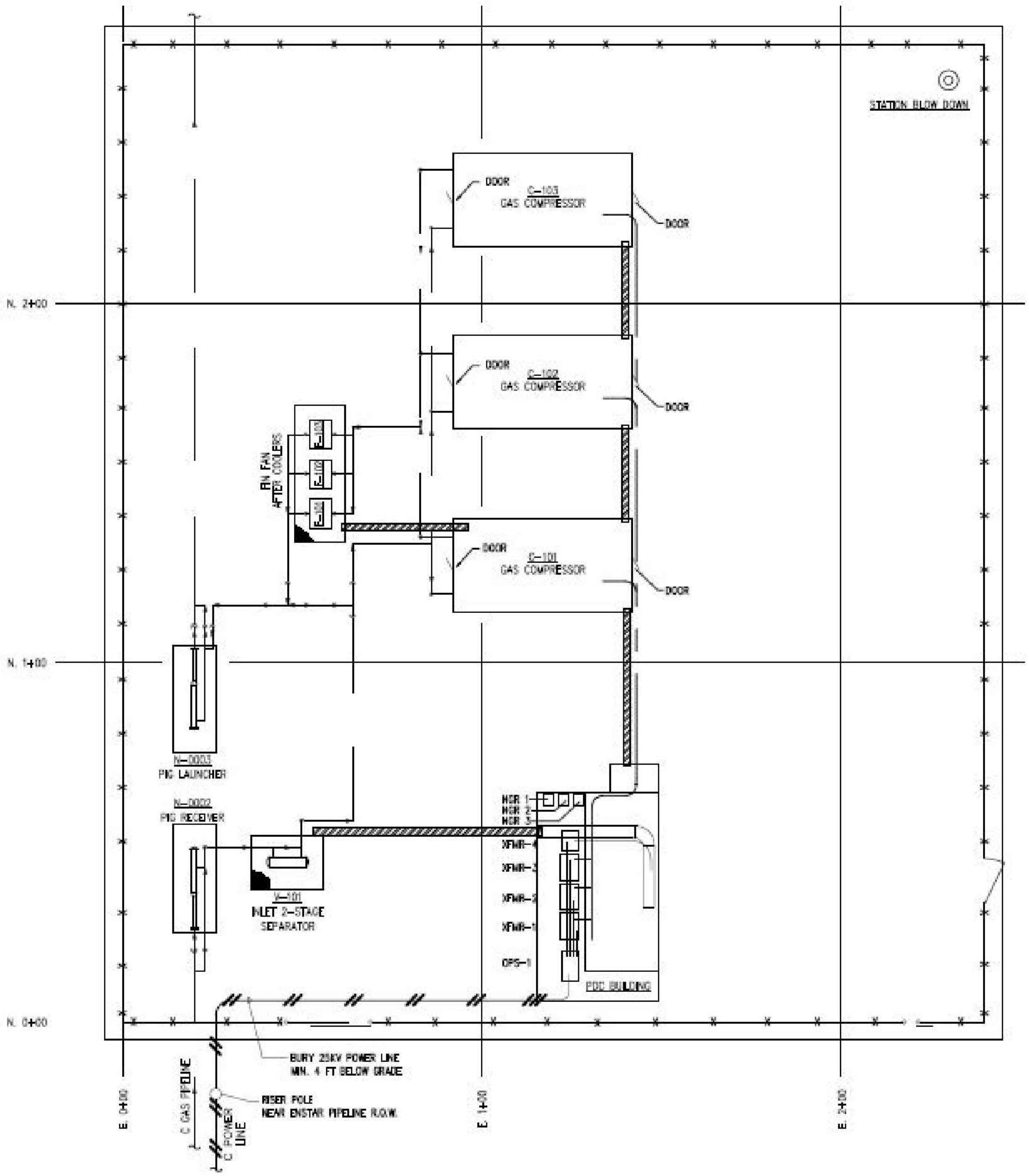
<u>Compressor Station</u>

The flow of natural gas through a pipeline causes friction, thereby increasing the pressure needed to efficiently move gas through the pipeline. Compressors are used to increase the pressure and keep the flow of natural gas moving through the pipeline at an appropriate rate. To meet the delivery requirements of 550 psig minimum pressure, one compressor station would be required. The approximately 1.5-acre facility would be located near MP 0.4 of the pipeline. The facility would be unmanned, with fully automated equipment operated by remote control. The workpad would be gravel, have a thickness of approximately 3 feet, and be approximately 240 feet by 272 feet in plan dimension (Figure 2.3-17). No provisions would be made for short- or long-term human occupancy at the site.

The compressor station would have two main components: electrically powered natural gas compression machines; and after-coolers provided to reduce gas temperature following the compression process. Three compressors of approximately 1,000 horsepower each would be used to deliver natural gas at different rates and pressures, depending on the fuel consumption demands of the mine project. Only two compressors would be required in order to meet current design flow conditions; the third would function as a backup compressor.

<u>Transmission Line</u>

Power for the metering station and compressor station at MP 0.4 would be provided by a medium voltage above-ground transmission line from the Beluga Power Plant substation, as shown on Figure 2.3-15. The approximately 8-mile transmission line would follow the Chugach Electric Association high-voltage transmission line corridor to the connection with the Beluga pipeline and then would follow the pipeline ROW. A portion of the proposed transmission line to power the compressor station crosses private surface-estate land owned by CIRI within the Kenai Peninsula Borough.



SITE INFORMATION
FENCE LINE: 240'-0" x 272'-0"
AREA: APPROX. 1.5 ACRES

NOTES:

1. NO PROVISIONS MADE FOR TEMPORARY OR PERMANENT HUMAN OCCUPANCY.

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ALTERNATIVE 2
COMPRESSOR STATION
SITE PLAN

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FIGURE 2.3-17

Pig Launcher and Receiver Station

Pig launcher and receiver barrels would be designed to be able to launch or receive both maintenance and in-line smart pigs. A pig launcher assembly with a compact footprint would be located at the start of the pipeline (MP 0). The launcher barrel would be configured for above-grade, permanent installation. The compressor station (MP 0.4) would have one set of standard design receiver and launcher assemblies. A midpoint receiver / launcher facility would be located near Farewell (MP 156), and the terminus of the pipeline at the mine site would have a pig receiver. The Farewell station would be accessed from the Farewell Airstrip (see Figure 2.3-18).

All of the pigging launcher and receiver sites include above-ground piping, valves, and valve controls as shown on Figure 2.3-19. The valves, valve controls, and the pig launcher and receiver doors at each location would be fitted with locks. Each launcher or receiver would have a trolley structure above the end of the barrel for hoisting the pigs into and out of the barrels. The pigging launcher and receiver sites are within above-ground facilities already proposed for use for other pipeline / project components, except the site near Farewell (MP 156). The pigging launcher and receiver site near Farewell would be approximately 0.2 acres (8,712 square feet [sf]). All these facility sites would be fenced, with sliding gates and locks to provide security.

Pipeline Launcher and Receiver Terminology

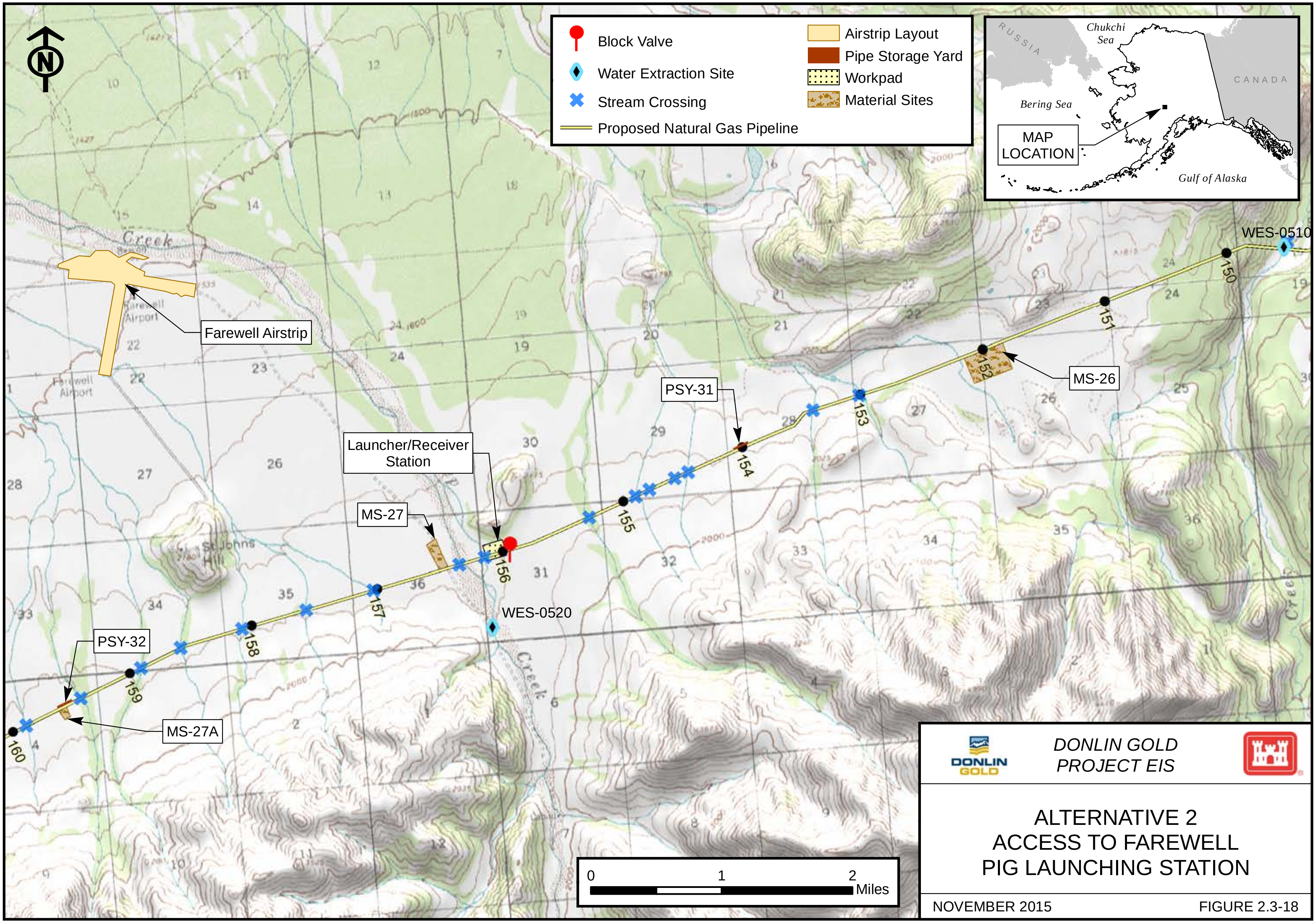
Pig *–a mechanical tool used to clean and/or inspect the interior of a pipeline.*

Pig launcher *– a facility on a pipeline for inserting and launching a pig.*

Pig receiver *– a piping arrangement whereby an incoming pig can be diverted into a receiving cylinder, isolated, and then removed.*

Metering Stations

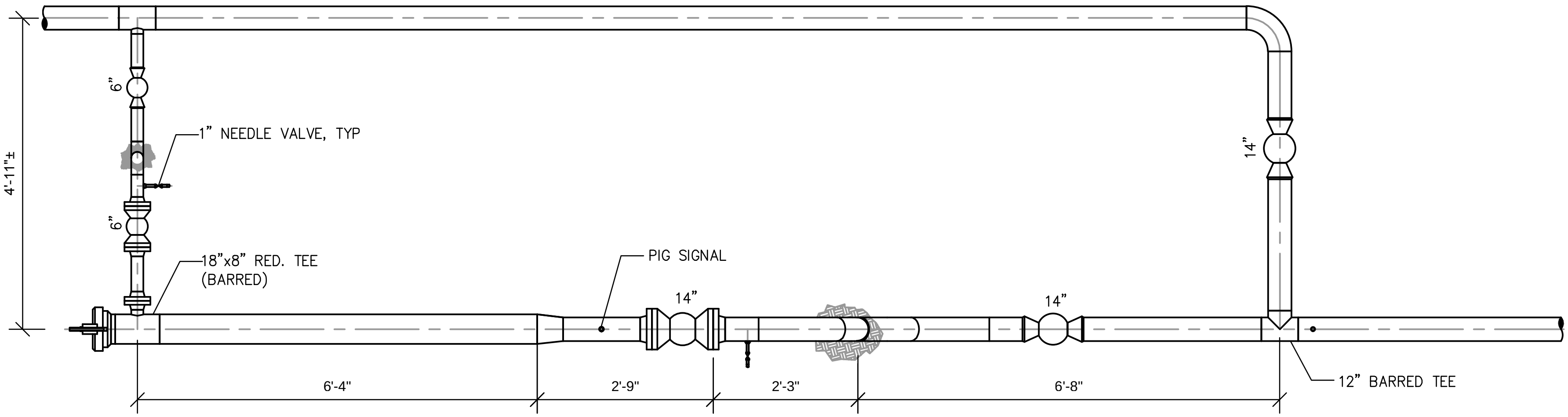
Metering stations (to measure the volume of gas) would be located at the pipeline tie-in (MP 0) and at the terminus (MP 315). The station at the mine site would include limited above-ground piping and a module that would house the metering equipment as shown on Figure 2.3-20. The pipeline terminus pad would be 100 feet by 100 feet and would have locking man-doors. The tie-in location at MP 0 would be 120 feet by 53 feet, fenced, with a sliding gate and lock.



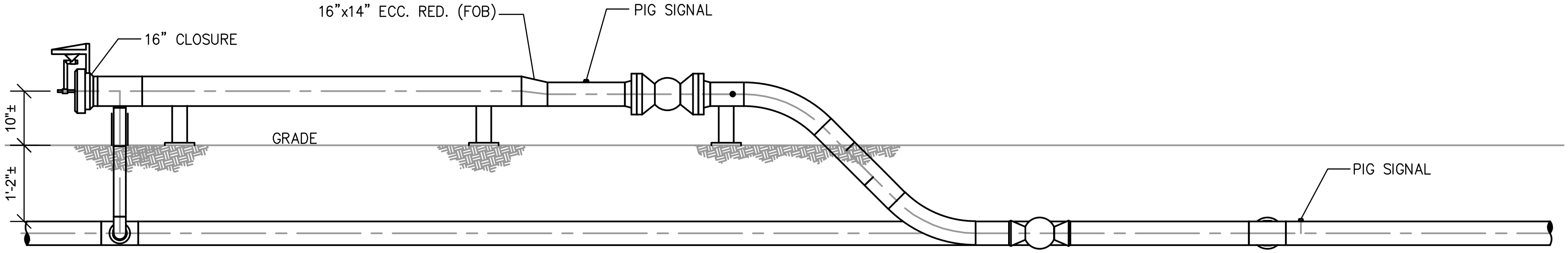
ALTERNATIVE 2
ACCESS TO FAREWELL
PIG LAUNCHING STATION

NOVEMBER 2015

FIGURE 2.3-18



PLAN
SCALE: 3/8"=1'-0"



ELEVATION
SCALE: 3/8"=1'-0"

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ALTERNATIVE 2
TYPICAL PIG LAUNCHER

NOVEMBER 2015

FIGURE 2.3-19

Mainline Valves

MLVs would be placed at intervals of no more than 20 miles along the length of the pipeline. A total of 20 MLVs would be installed at locations identified in Table 2.3-15.

Four of the valves would be located with other facilities: the Beluga Pipeline (BPL) tie-in, the compressor station, the Farewell pig launcher/receiver site, and the pipeline terminus at the mine site. Three of these, located at the Beluga Pipeline (BPL) tie-in, the compressor station, and the pipeline terminus, would function as emergency shutdown (ESD) valves, and would be able to be remotely and/or automatically operated by a Supervisory Control and Data Acquisition (SCADA) system. These ESD valves could also be manually operated by the activation of an ESD switch at any of the three sites by an on-site operator if necessary. Figure 2.3-21 shows a typical MLV assembly.

Table 2.3-15: Mainline Valve Location Summary

No.	TAG	MP (Approx.)
1	MLV-01	0.00
2	MLV-02	0.43
2A	MLV-2A	11.89
3	MLV-03	26.78
4	MLV-04	45.78
5	MLV-05	64.82
6	MLV-06	84.82
7	MLV-07	101.80
8	MLV-08	120.86
9	MLV-09	137.06
10	MLV-10	155.94
11	MLV-11	175.39
12	MLV-12	195.04
13	MLV-13	214.32
14	MLV-14	231.33
15	MLV-15	251.33
16	MLV-16	271.33
17	MLV-17	291.32
18	MLV-18	303.33
19	MLV-19	315.19

Source: : SRK 2013b.

The remaining 16 block valve locations would consist of valve operators, small-bore piping, and associated valves above-ground. All of these valves would be manually operated and fitted with locks and a signpost similar to the pipeline MP markers. These 25 X 25 foot (625 sf) block valve sites would be fenced and have sliding gates with locks; no structures are planned for these sites. The specific locations of these 16 block valves would be determined during the final pipeline design process.

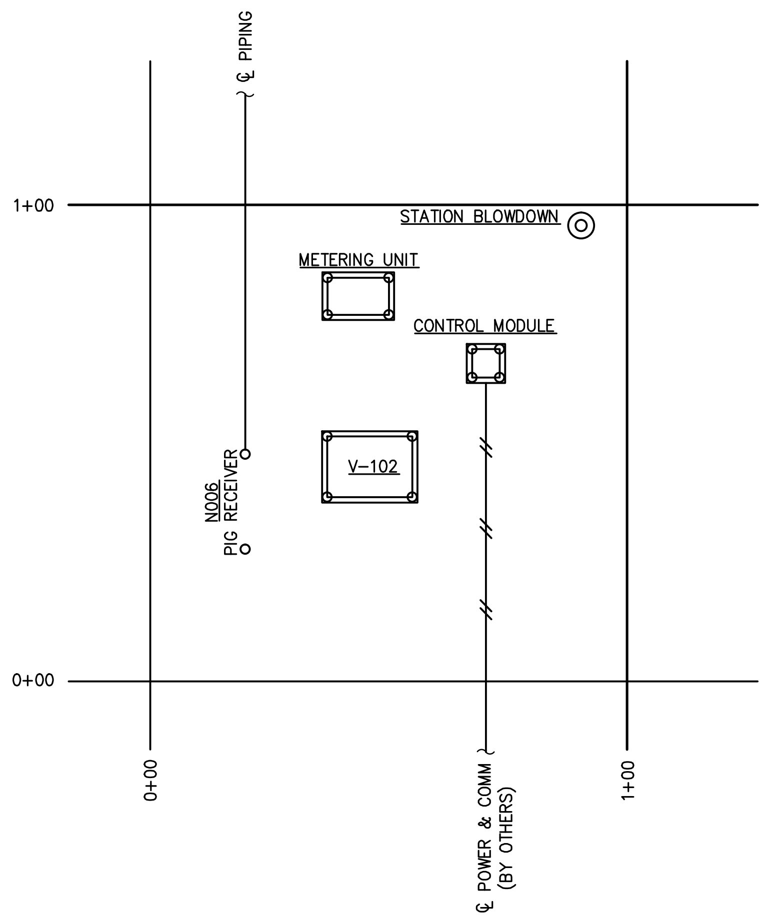
2.3.2.3.4 PIPELINE – TEMPORARY WORK AREAS OUTSIDE OF RIGHT-OF-WAY

Donlin Gold would clear temporary extra workspace as required outside of the authorized 150-foot construction corridor. Temporary extra workspaces would be required at:

- stream and river crossings, and high banks at ravines where earth cuts are required;
- areas where pipe is being installed using HDD methods, to accommodate extra equipment;
- sidebends;
- the beginning and end of each construction spread for spread mobilization and demobilization;
- stringing truck turnaround areas;
- other areas where extra space for spoil storage and construction activities are necessary;
- areas of sideslopes where grade cuts are required to create a level work surface across the width of the ROW (the extra width needed for the cuts and / or the fills) as shown on Figure 2.3-22;
- areas where a high water table would undermine trench walls, creating an extra-wide trench and larger spoil piles (for instance, in a gravel floodplain);
- on steep grades or for shoofly (temporary) access roads around such grades; and
- pipe laydown areas.

During pipeline and transmission line construction, additional areas for construction camps, pipeline and construction material storage yards, material source sites and airstrips would also be required. These facilities requiring upgrading or new construction would be constructed before initiation of pipeline construction. Ancillary facilities that are currently being used or planned for use by Donlin Gold and others would require negotiations and leases or use agreements. These facilities are included in the estimates of area to be cleared and the acreage totals shown in Table 2.3-14 above.

In addition to the temporary work areas, temporary access roads would be required during construction, and these are included in this analysis. These include a winter access corridor (ice road) and gravel temporary and shoofly roads. Many of the temporary access roads lead to water extraction sites. Water use and potential extraction sites are also discussed in this section.



UNITS AND WEIGHTS:

PAD: 100'–0" x 100'–0"
AREA: APPROX. 0.25 ACRES

UNITS AND WEIGHTS:

STATION BLOWDOWN 30'x12'
PIG RECEIVER: 2500 LBS PIPING 1000 LBS RECEIVER DOOR
V–102 20'x15' PLATFORM
METERING UNIT 10'x15'x13' TALL
CONTROL MODULE 8'x8'

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ALTERNATIVE 2
TYPICAL METERING STATION

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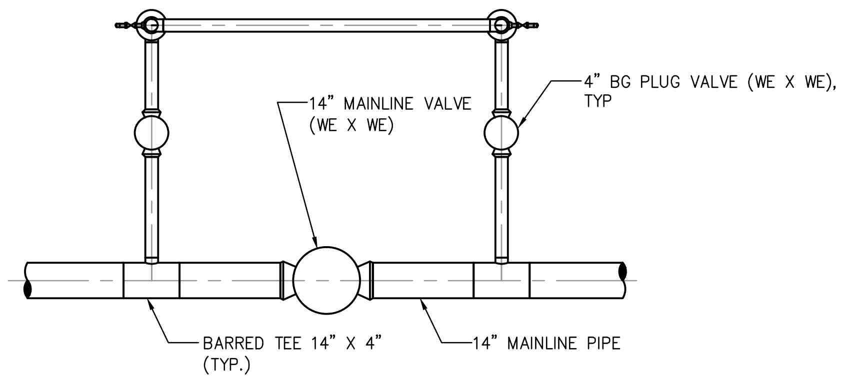
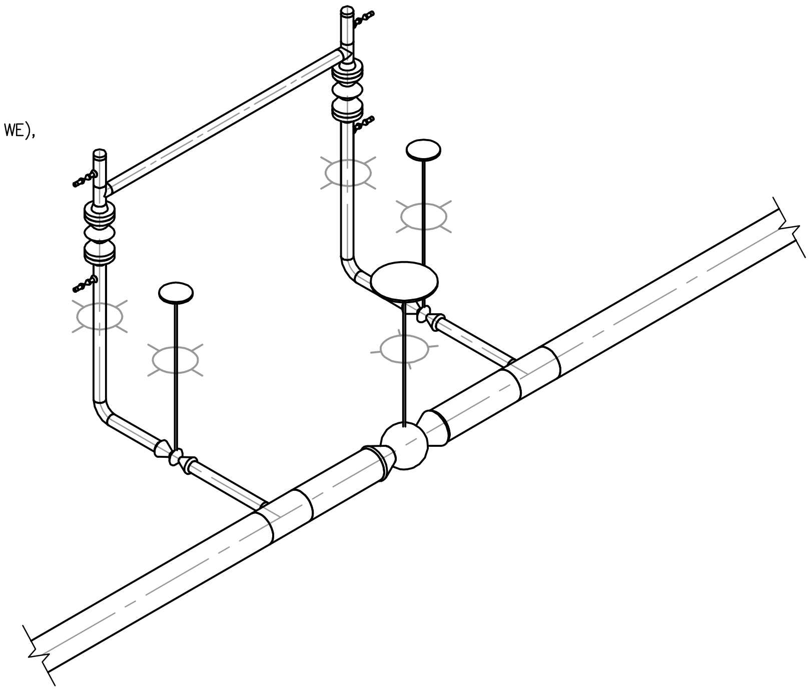
FIGURE 2.3-20

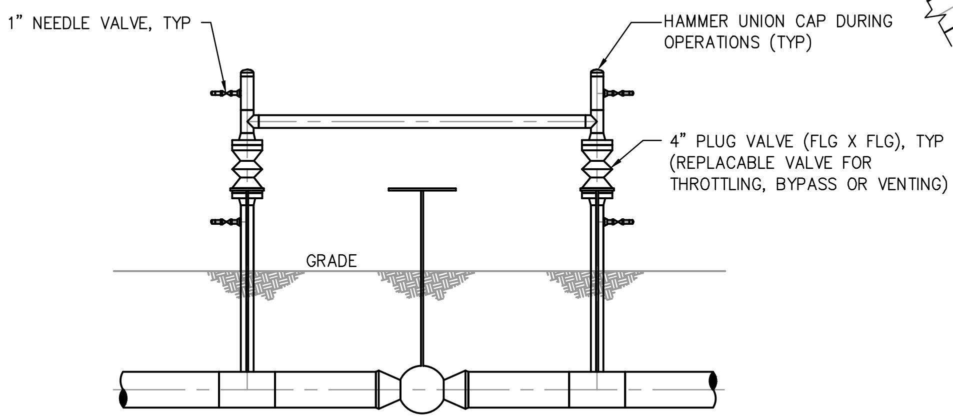


(HANDWHEELS NOT SHOWN FOR CLARITY)

PLAN

SCALE: 1/2"=1'-0"





ELEVATION

SCALE: 1/2"=1'-0"

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ALTERNATIVE 2
TYPICAL MAIN LINE BLOCK VALVE

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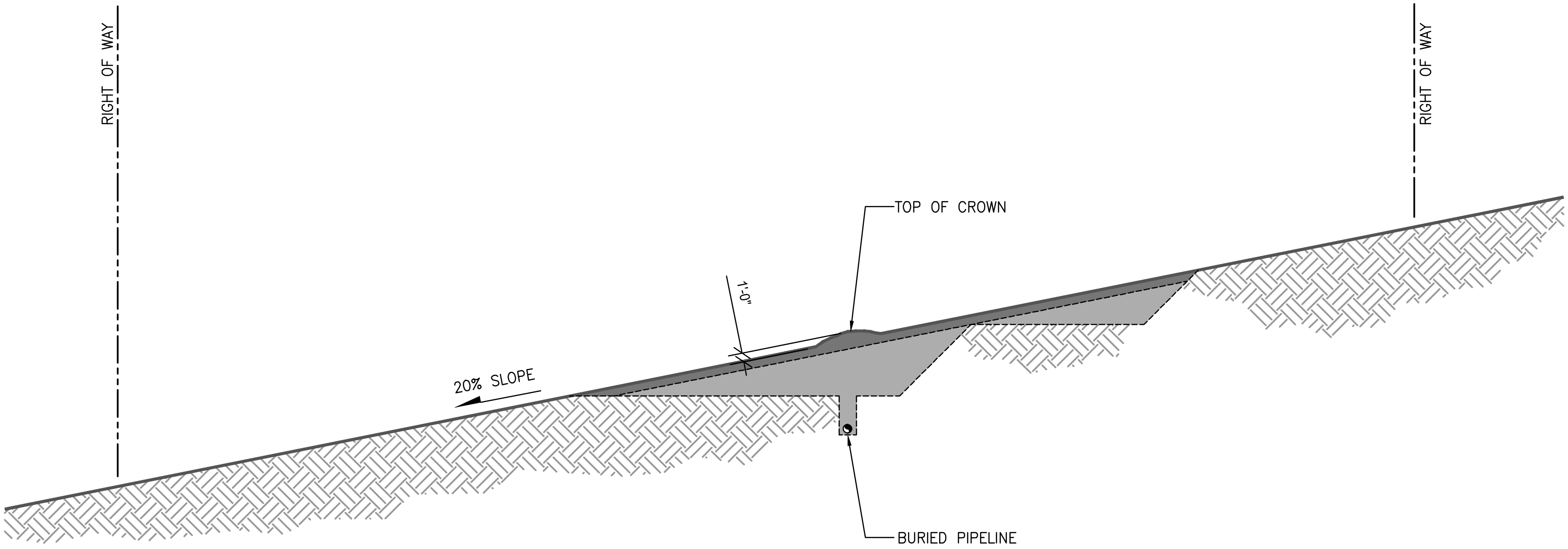
FIGURE 2.3-21



RECLAIMED RIGHT OF WAY
NOT TO SCALE

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PROJECT EIS

ALTERNATIVE 2
TYPICAL SIDE SLOPE SECTION

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FIGURE 2.3-22

Winter Access Corridor

Donlin Gold proposes to develop an approximately 46- to 50-mile, 30-foot wide winter access corridor to transport equipment and supplies for a period of approximately 3 years from the Parks Highway via Petersville Road or at Willow via the Willow Creek Parkway (Figure 2.3-23). The estimated maximum usage of the road would be 135 days/year for up to three years (December through mid-April). Each of the two route options has been determined to be viable and the majority of each route has previously been utilized as commercial/industrial winter trails to support oil and gas exploration, mineral exploration and development, as well as materials and fuel transport for the numerous lodges and commercial activities in the Yentna and Skwentna River drainages. Since each route has distinct advantages depending on specific winter season conditions, and likely, but undetermined future use by other parties, it is appropriate to carry forward two primary route options. The 46-mile long northern route alternative is identified as the “Oilwell Road Route” (OWRR). The 50-mile long southern route is identified as the “Willow Landing Route” (WLR). Each primary route includes several spur options (secondary routes) which provide for access to the pipeline corridor at several different locations. In addition each of the primary routes share the same corridor for the final approximately 12 miles approaching the pipeline corridor at its crossing of the Skwentna River (approximately MP 50). Ultimately the project would utilize one of the primary routes and each of the spur routes that access MP 32 and MP 43. A map of proposed winter construction access route options is provided on Figure 2.3-23.

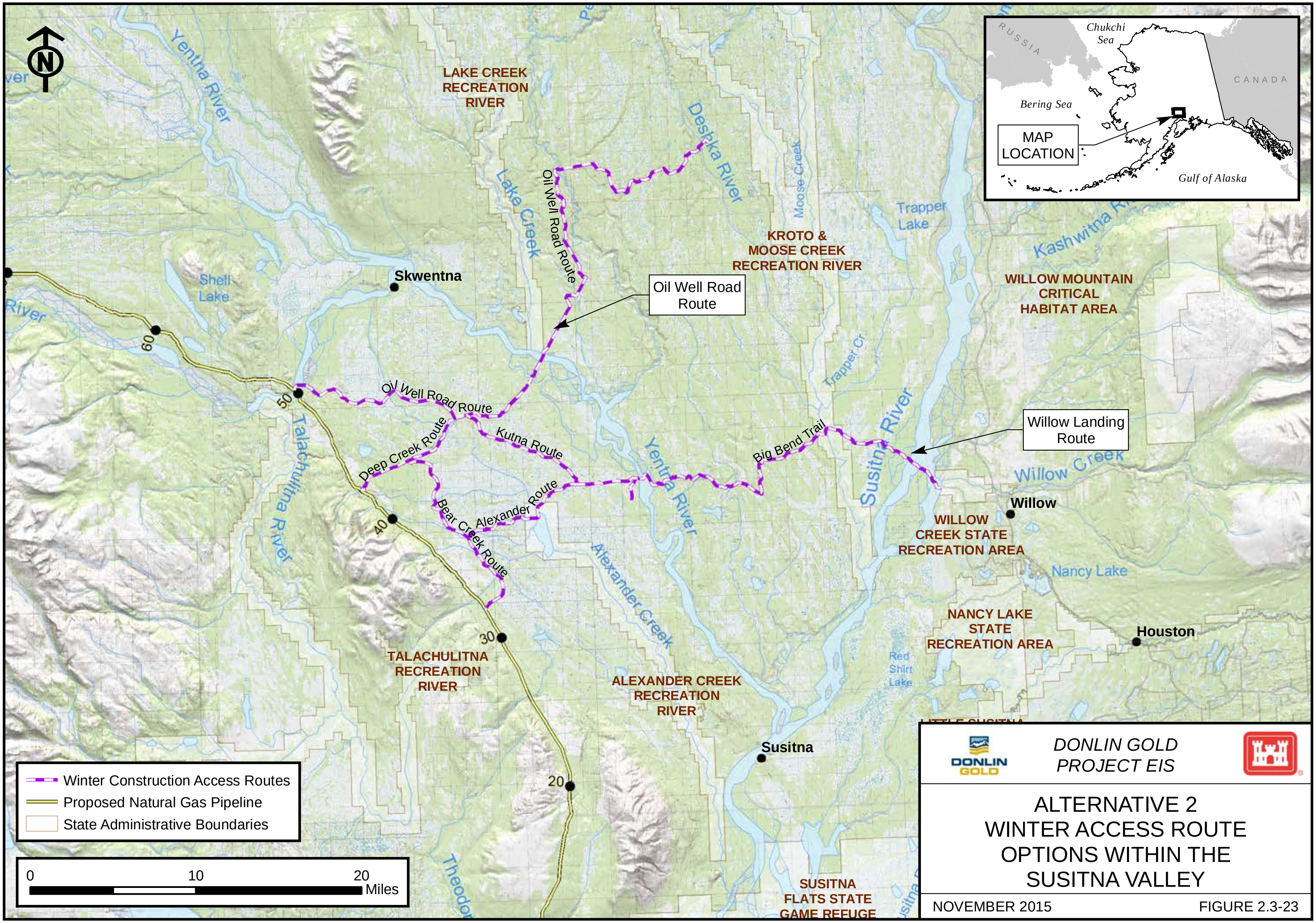
Clearing along the route chosen would begin in the winter prior to pipeline construction as soon as the ground becomes sufficiently frozen to support the weight of equipment. Clearing would be done such that the ground would not be damaged and erosion or long-term vegetation loss would not occur. Maintenance of the winter access ROW would occur only during the winter months by packing, watering, and grading the snow and ice surface.

Table 2.3-16 summarizes the details regarding the potential winter access routes shown on Figure 2.3-23.

Table 2.3-16: Winter Access Routes within Susitna Valley

Name	Nearest Milepost (MP)	Length	Class	Season of Use		
				Summer	Winter	All Season
Big Bend Trail	MP 32	26.54 miles	Construction Access		X	
Bear Creek Route	MP 32	13.13 miles	Construction Access		X	
Deep Creek Route	MP 43	7.81 miles	Construction Access		X	
Oil Well Road Route	MP 50	45.61 miles	Construction Access		X	
Kutna Route	MP 38	12.23 miles	Construction Access		X	
Alexander Route	MP 36	8.68 miles	Construction Access		X	

Notes:
MP = mile post
Source: SRK 2013b.



DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
WINTER ACCESS ROUTE OPTIONS WITHIN THE SUSITNA VALLEY

NOVEMBER 2015

FIGURE 2.3-23

Water Use and Potential Water Extraction Sites

Anticipated water needs and water extraction locations for the winter use corridor are provided in Table 2.3-17. Estimated annual water use requirements during construction from other sources are shown in Table 2.3-18. Table 2.3-19 shows the specific water requirements for each HDD crossing. Final estimated quantities for specific uses would be determined during final design. Water required for camp use during construction would be supplied from wells or clean water sources and would be piped or trucked to a water treatment facility. There would also be water storage at each camp for fire suppression. Water would also be needed for other uses including ice road construction, dust control, reclamation and hydrostatic testing and HDD operations. Water withdrawal from lakes and streams would be planned and executed in accordance with the requirements of the appropriate permits and authorizations. Temporary water use authorizations would be applied for by either the appropriate contractor or Donlin Gold.

Temporary Access Roads and Shoofly Roads

Temporary site access and shoofly roads would be required for airstrips, borrow material sites, water withdrawal sites, and other authorized temporary use areas such as pipeline storage yards. A shoofly road is defined as an access road to the pipeline construction ROW or along the ROW to provide continuous access where the ROW is too steep for pipe stringing trucks and personnel carriers.

Temporary gravel access roads would be a maximum of 24 feet wide, with culverts installed as necessary to facilitate surface water flow. Road shoulders surrounding culverts would be lined with rip-rap (or equivalent per the erosion and sediment control plan). Table 2.3-20 identifies planned temporary access roads and the corresponding pipeline MP. The temporary roads would total about 156 miles in length and would encompass just under 49 acres. In addition to these roads, 75 shoofly roads ranging from 0.09 miles to 6.91 miles in length and totaling about 77 miles would be needed. Reclamation of these roads is described in Section 2.3.2.3.6.

Table 2.3-17: Susitna Valley Winter Access Potential Water Extraction Sites for Ice Road Construction

Water Extraction Site Name	Route	Season of Use			Water Body Type	Years of Use	Extraction	
		Summer	Winter	All Season			Rate (gpm)	Annual Volume (gal)
WEX-Texas	Bear Creek Route		x		Creek	2	500	1,500,000
WEX-Bear	Bear Creek Route		x		Creek	2	500	2,400,000
WEX-Susitna	Big Bend Trail		x		River	2	500	3,600,000
WEX-Deshka	Big Bend Trail		x		River	2	500	3,600,000
WEX-Fish	Big Bend Trail		x		Creek	2	500	4,200,000
WEX-Yentna-S	Big Bend Trail		x		River	2	500	4,200,000
WEX-Eightmile	Oil Well Road Route		x		Creek	2	500	4,800,000
WEX-Kutna	Big Bend Trail		x		Creek	2	500	2,400,000
WEX-Clear	Bear Creek Route		x		Creek	2	500	2,400,000
WEX-Deep-W	Bear Creek Route		x		Creek	2	500	3,000,000
WEX-Sevenmile-N	Deep Creek Route		x		Creek	2	500	1,800,000
WEX-Twentymile	Oil Well Road Route		x		Slough	2	500	4,800,000
WEX-Yentna-N	Oil Well Road Route		x		River	2	500	4,800,000
WEX-Kahiltna	Oil Well Road Route		x		River	2	500	7,800,000
WEX-Chijuk-E	Oil Well Road Route		x		Tributary	2	500	2,400,000
WEX-Chijuk-W	Oil Well Road Route		x		Tributary	2	500	5,400,000
WEX-Deep-E	Alexander Route		x		Creek	2	500	2,100,000
WEX-Fox	Alexander Route		x		Creek	2	500	2,100,000
WEX-Sevenmile-S	Deep Creek Route		x		Tributary	2	500	2,700,000

Notes:

gal = gallons
gpm = gallons per minute
MP = milepost

Source: SRK 2013b.

Table 2.3-18: Potential Water Extraction Sites for Pipeline Construction

Water Extraction Site Name	Nearest Milepost (MP)	Season of Use			Water Body Type	Years of Use	Extraction	
		Summer	Winter	All Season			Rate (gpm)	Annual Volume (gal)
WES-0010	MP 0		X		River	1	500	3,430,000
WES-0020	MP 5		X		River	1	500	3,860,000
WES-0030	MP 10		X		Pond	1	500	500,000
WES-0031	MP 9		X		Pond	1	500	500,000
WES-0040	MP 12		X		Tributary	1	100	50,000
WES-0050	MP 14		X		Tributary	1	100	50,000
WES-0060	MP 17		X		Creek	1	500	1,200,000
WES-0070	MP 19		X		Tributary	1	500	1,200,000
WES-0080	MP 21		X		Tributary	1	500	1,200,000
WES-0085	MP 23		X		Creek	1	100	500,000
WES-0090	MP 26		X		Creek	1	250	1,200,000
WES-0095	MP 27		X		Creek	1	250	1,600,000
WES-0096	MP 29		X		Creek	1	500	1,200,000
WES-0100	MP 30		X		Tributary	1	100	1,200,000
WES-0110	MP 33		X		Creek	1	500	1,800,000
WES-0115	MP 35		X		Creek	1	500	1,200,000
WES-0120	MP 37		X		Creek	1	500	1,200,000
WES-0130	MP 39		X		Tributary	1	500	1,200,000
WES-0140	MP 39		X		Creek	1	500	1,200,000
WES-0145	MP 41		X		Creek	1	500	1,200,000
WES-146	MP 42		X		Creek	1	500	1,930,000
WES-0150	MP 43		X		Creek	1	500	1,200,000
WES-0160	MP 45		X		Creek	1	250	1,200,000
WES-165	MP 47		X		Pond	1	500	600,000
WES-0170	MP 48		X		Pond	1	500	1,200,000
WES-0180	MP 50		X		River	2	600	5,265,000
WES-0190	MP 53		X		Creek	2	500	900,000
WES-0200	MP 53		X		Creek	2	500	1,200,000
WES-0210	MP 56		X		River	2	500	1,200,000
WES-0220	MP 56		X		Pond	2	500	1,200,000
WES-0230	MP 59		X		Stream	2	500	1,200,000
WES-235	MP 62		X		Stream	2	500	1,200,000
WES-0240	MP 63		X		Stream	2	500	1,200,000
WES-0245	MP 64		X		Stream	2	500	1,200,000
WES-0255	MP 66		X		Stream	2	500	1,200,000
WES-0260	MP 68		X		Stream	2	100	100,000
WES-0265	MP 72		X		Stream	2	250	1,200,000
WES-0270	MP 73		X		Pond	2	500	1,200,000
WES-0275	MP 75		X		Stream	2	500	1,200,000
WES-0276	MP 75		X		Stream	2	500	1,200,000
WES-0280	MP 79		X		Creek	2	500	1,200,000

Table 2.3-18: Potential Water Extraction Sites for Pipeline Construction

Water Extraction Site Name	Nearest Milepost (MP)	Season of Use			Water Body Type	Years of Use	Extraction	
		Summer	Winter	All Season			Rate (gpm)	Annual Volume (gal)
WES-0290	MP 81		X		Creek	2	500	1,200,000
WES-0300	MP 84		X		Pond	2	500	1,200,000
WES-0310	MP 86		X		River	2	600	5,475,000
WES-0320	MP 88		X		Lake	2	500	2,000,000
WES-0330	MP 90		X		Lake	2	500	3,000,000
WES-0340	MP 95		X		Creek	2	500	2,400,000
WES-0350	MP 99		X		Creek	2	250	1,200,000
WES-0360	MP 101		X		Creek	2	500	1,200,000
WES-0370	MP 103		X		Creek	2	500	3,000,000
WES-0380	MP 106		X		Creek	2	500	1,200,000
WES-0410	MP 108		X		River	2	600	1,425,000
WES-0418	MP 112	X	X	X	Stream	2	500	2,210,000
WES-0419	MP 112	X	X	X	Creek	1	500	100,000
WES-0420	MP 114	X			Tributary	1	500	100,000
WES-0425	MP 116	X			Tributary	1	500	100,000
WES-0430	MP 120	X			Tributary	1	500	100,000
WES-0435	MP 120	X			Tributary	1	500	100,000
WES-0438	MP 121	X			Tributary	1	500	100,000
WES-0440	MP 123	X			Creek	1	500	100,000
WES-0445	MP 125	X			Tributary	1	500	100,000
WES-0447	MP 126	X			Tributary	1	500	100,000
WES-0450	MP 127	X			River	1	500	3,000,000
WES-0460	MP 130	X			Pond	1	500	150,000
WES-0462	MP 131	X			River	1	500	150,000
WES-0464	MP 132	X			Tributary	1	500	600,000
WES-0466	MP 133	X			Tributary	1	500	150,000
WES-0468	MP 134	X			Spring	1	500	150,000
WES-0470	MP 137	X			River	1	500	150,000
WES-0475	MP 137	X			River	1	500	150,000
WES-0480	MP 140	X			Tributary	1	500	150,000
WES-0490	MP 145	X	X	X	Tributary	2	500	1,355,000
WES-0500	MP 146		X		River	2	500	4,075,000
WES-0505	MP 148		X		Tributary	2	500	1,800,000
WES-0510	MP 150		X		Creek	2	500	1,200,000
WES-0520	MP 156		X		Creek	2	500	2,400,000
WES-0530	MP 161		X		Creek	2	500	1,800,000
WES-0540	MP 164		X		Creek	2	500	1,800,000
WES-0545	MP 167		X		Pond	2	500	1,800,000
WES-0550	MP 168		X		River	2	500	4,290,000
WES-0560	MP 171		X		Creek	2	100	100,000
WES-0570	MP 174		X		Creek	2	100	100,000

Table 2.3-18: Potential Water Extraction Sites for Pipeline Construction

Water Extraction Site Name	Nearest Milepost (MP)	Season of Use			Water Body Type	Years of Use	Extraction	
		Summer	Winter	All Season			Rate (gpm)	Annual Volume (gal)
WES-0575	MP 174		X		Creek	2	500	2,400,000
WES-0580	MP 177		X		Creek	2	100	100,000
WES-0590	MP 179		X		Creek	2	100	100,000
WES-0595	MP 180		X		Creek	2	500	2,400,000
WES-0600	MP 183		X		River	2	500	4,290,000
WES-0610	MP 185		X		Creek	2	500	4,290,000
WES-0615	MP 186		X		Pond	2	500	1,200,000
WES-0620	MP 188		X		Pond	2	500	1,200,000
WES-0625	MP 189		X		Pond	2	500	1,200,000
WES-0630	MP 191		X		River	2	500	5,290,000
WES-0640	MP 193		X		Pond	2	500	3,000,000
WES-0650	MP 197		X		Pond	2	500	3,000,000
WES-0660	MP 198		X		Pond	2	500	3,000,000
WES-0670	MP 205		X		Creek	2	250	250,000
WES-0680	MP 208		X		Creek	2	100	250,000
WES-0690	MP 211		X		Creek	2	250	250,000
WES-0710	MP 217		X		River	2	500	4,675,000
WES-0715	MP 219		X		Creek	2	500	1,200,000
WES-0720	MP 221		X		Creek	2	500	1,200,000
WES-0730	MP 224		X		Creek	2	500	1,800,000
WES-0740	MP 227		X		Creek	2	100	100,000
WES-0750	MP 227		X		Creek	2	500	1,800,000
WES-0760	MP 232		X		Creek	2	500	3,750,000
WES-0770	MP 239	X	X	X	Creek	2	500	5,490,000
WES-0780	MP 245	X	X	X	Tributary	2	500	50,000
WES-0790	MP 241	X	X	X	Creek	1	600	975,000
WES-0800	MP 243	X	X	X	Creek	1	500	50,000
WES-0810	MP 245	X	X	X	Creek	1	250	500,000
WES-0815	MP 249	X			Creek	1	500	200,000
WES-0816	MP 256	X			Creek	1	500	1,790,000
WES-0820	MP 270	X			Creek	1	500	500,000
WES-0830	MP 283	X			River	1	600	2,745,000
WES-0835	MP 286	X			Creek	1	500	350,000
WES-0836	MP 288	X			Creek	1	500	100,000
WES-0840	MP 291	X			River	1	600	850,000
WES-0850	MP 298	X			River	1	600	2,925,000

Notes:

gal = gallons MP = milepost WES = water extraction site
gpm = gallons per minute

Source: SRK 2013b.

Table 2.3-19: HDD Estimated Water Use

HDD Crossing Name	Length	Estimated Total Water Requirement (gal)	Estimated Total Volume Solids/Cuttings Needing Disposal (cy)	Estimated Total Volume of Drilling Mud for Disposal (gal)
Skwentna River	2,981 ft	350,000-375,000	250-260	180,000-200,000
Happy River	3,453 ft	450,000-500,000	280-290	240,000-260,000
Kuskokwim River	7,101 ft	900,000-925,000	590-600	440,000-460,000
East Fork George River	4,532 ft	500,000-525,000	375-385	250,000-270,000
George River	2,957 ft	325,000-350,000	245-255	160,000-180,000
North Fork George River	3,281 ft	425,000-450,000	270-280	220,000-240,000

Notes:

cy = cubic yards
gal = gallons

Source: SRK 2013b

Table 2.3-20: Access Road Identification

Name	Mile Post	Length (miles)	Acres*	Description	Winter	Summer	All Season
Public Road Access	0			Existing access from Beluga Airport to MP 0	X	X	X
Public Road Access	0			Existing Pretty Creek Road	X	X	X
AWES-0030	10	0.43	1.25	Water Extraction Site Access	X		
AWES-0031	10	0.23	0.67	Water Extraction Site Access	X		
AWES-0080	21	0.82	2.38	Water Extraction Site Access	X		
AWES-0085	22	0.46	1.33	Water Extraction Site Access	X		
AWES-0115	35	1.52	5.38	Water Extraction Site Access	X		
AWES-0140	39	0.85	2.47	Water Extraction Site Access	X		
AWES-0165	47	0.10	0.29	Water Extraction Site Access	X		
AWES-0170	48	0.33	0.96	Water Extraction Site Access	X		
AWES-0190	53	0.18	0.52	Water Extraction Site Access	X		
AWES-0210	56	0.05	0.15	Water Extraction Site Access	X		
AWES-0220	56	0.51	1.48	Water Extraction Site Access	X		
AMS-11	56	0.87	2.52	Material Site Access			
AWES-0245	64	0.08	0.23	Water Extraction Site Access	X		
AWES-0270	73	0.16	0.46	Water Extraction Site Access	X		
AWES-0300	84	0.12	0.35	Water Extraction Site Access	X		

Table 2.3-20: Access Road Identification

Name	Mile Post	Length (miles)	Acres*	Description	Winter	Summer	All Season
AWES-0310	86	0.09	0.26	Water Extraction Site Access	X		
AWES-0320	88	0.10	0.29	Water Extraction Site Access	X		
AWES-0330	90	0.13	0.38	Water Extraction Site Access	X		
AWES-0350	99	0.06	0.17	Water Extraction Site Access	X		
AWES-0380	106	0.26	0.75	Water Extraction Site Access	X		
AWES-00418	112	0.06	0.17	Water Extraction Site Access	X	X	X
AMS-17C	114	0.25	0.73	Material Site Access	X		
AWES-0460	130	0.05	0.15	Water Extraction Site Access	X		
AWES-0462	131	0.05	0.15	Water Extraction Site Access	X		
AWES-0490	145	0.34	0.99	Water Extraction Site Access	X	X	X
AWES-0520	156	0.60	1.74	Water Extraction Site Access	X		
AASSS-Farewell	156	2.98	8.64	Airstrip Access	X	X	X
AWES-0545	167	0.07	0.20	Water Extraction Site Access	X		
AWES-0615	186	0.19	0.55	Water Extraction Site Access	X		
AWES-0620	188	0.14	0.41	Water Extraction Site Access	X		
AWES-0625	189	0.10	0.29	Water Extraction Site Access	X		
AWES-0640	193	0.40	1.16	Water Extraction Site Access	X		
AWES-0650	197	0.06	0.17	Water Extraction Site Access	X		
AWES-0660	198	0.42	1.22	Water Extraction Site Access	X		
AMS-42	213	0.24	0.69	Material Site Access	X		
AMS-44	223	0.47	1.36		X		
AMS-0730	224	0.45	1.31	Water Extraction Site Access	X		
AWES-0750	224	1.17	3.39	Water Extraction Site Access	X		
AWES-0770	227	0.10	0.29	Water Extraction Site Access	X	X	X
AMS-50	239	0.08	0.23	Water Extraction Site Access	X	X	X
AWP-Kusko NE	240	0.70	2.03	Work Pad	X	X	X
AWES-0790	241	0.14	0.41	Water Extraction Site Access	X	X	X
AWES-0810	245	0.10	0.29	Water Extraction Site Access	X	X	X
Total	310	16.51	48.86				

Notes:

* Based on 24-foot width

Source: SRK 2013b.

Table 2.3-21 provides details on the location, season of use, and approximate length and acreage of each planned shoofly road. Assuming a maximum width of 24 feet, these shoofly roads would temporarily cover 224.6 acres.

Table 2.3-21: Shoofly Access Routes

Name	Approximate Milepost (MP)	Length (miles)	Acres*	Season of Use		
				Summer	Winter	All Season
SHOO-0005	MP 4.7	0.71	2.07	X	X	X
SHOO-0010	MP 11.4	0.84	2.44		X	
SHOO-0020	MP 14.3	0.48	1.40		X	
SHOO-0030	MP 16.8	0.26	0.76		X	
SHOO-0040	MP 19.8	1.06	3.08		X	
SHOO-0050	MP 45	0.31	0.90		X	
SHOO-0060	MP 49.5	0.63	1.83		X	
SHOO-0070	MP 50.6	0.24	0.70		X	
SHOO-0080	MP 51	0.85	2.47		X	
SHOO-0090	MP 59.3	0.15	0.44		X	
SHOO-0100	MP 68	0.11	0.32		X	
SHOO-0110	MP 70.5	0.09	0.26		X	
SHOO-0120	MP 75.2	0.3	0.87		X	
SHOO-0130	MP 85.8	1.64	4.77		X	
SHOO-0140	MP 87	1.19	3.46		X	
SHOO-0150	MP 88.1	0.33	0.96		X	
SHOO-0160	MP 98.2	0.2	0.58		X	
SHOO-0170	MP 102.6	0.63	1.83		X	
SHOO-0180	MP 108.3	0.64	1.86		X	
SHOO-0190	MP 108.7	0.37	1.08		X	
SHOO-0200	MP 115.9	0.68	1.98	X		
SHOO-0210	MP 116.6	0.78	2.27	X		
SHOO-0220	MP 119.7	0.30	0.87	X		
SHOO-0230	MP 120.1	0.36	1.05	X		
SHOO-0240	MP 124.9	0.39	1.13	X		
SHOO-0250	MP 126.3	0.21	0.61	X		
SHOO-0260	MP 126.7	0.86	2.50	X		
SHOO-0270	MP 127.5	1.22	3.55	X		
SHOO-0280	MP 128.5	0.64	1.86	X		
SHOO-0290	MP 137.1	0.14	0.41	X		

Table 2.3-21: Shoofly Access Routes

Name	Approximate Milepost (MP)	Length (miles)	Acres*	Season of Use		
				Summer	Winter	All Season
SHOO-0300	MP 137.7	0.74	2.15	X		
SHOO-0310	MP 139.8	0.59	1.72	X		
SHOO-0320	MP 141	0.17	0.49	X		
SHOO-0330	MP 142	0.13	0.38	X		
SHOO-0340	MP 142.9	1.6	4.65	X		
SHOO-0350	MP 149	0.49	1.43		X	
SHOO-0360	MP 149.6	1.27	3.69		X	
SHOO-0370	MP 167.8	0.17	0.49		X	
SHOO-0380	MP 168.2	1.03	3.00		X	
SHOO-0390	MP 182.4	0.19	0.55		X	
SHOO-0400	MP 182.9	0.67	1.95		X	
SHOO-0410	MP 186	0.24	0.70		X	
SHOO-0420	MP 191.9	0.63	1.83		X	
SHOO-0430	MP 197.1	1.06	3.08		X	
SHOO-0440	MP 234.9	3.12	9.08	X	X	X
SHOO-0450	MP 236	4.8	13.9	X	X	X
SHOO-0460	MP 240.9	6.91	20.1	X	X	X
SHOO-0470	MP 246.9	0.36	1.05	X	X	X
SHOO-0480	MP 248.5.	1.92	5.59	X		
SHOO-0490	MP 255.9	1.14	3.32	X		
SHOO-0500	MP 258.8	2.99	8.70	X		
SHOO-0510	MP 262.9	2.13	6.20	X		
SHOO-0520	MP 268.8	1.68	4.89	X		
SHOO-0530	MP 270.2	1.46	4.25	X		
SHOO-0540	MP 272.9	0.72	2.09	X		
SHOO-0550	MP 274.3	0.47	1.37	X		
SHOO-0560	MP 275.9	0.38	1.11	X		
SHOO-0570	MP 276.9	0.46	1.34	X		
SHOO-0580	MP 277.6	0.35	1.02	X		
SHOO-0590	MP 278.6	0.59	1.72	X		
SHOO-0600	MP 279.4	0.41	1.19	X		

Table 2.3-21: Shoofly Access Routes

Name	Approximate Milepost (MP)	Length (miles)	Acres*	Season of Use		
				Summer	Winter	All Season
SHOO-0610	MP 280.8	0.73	2.12	X		
SHOO-0620	MP 281.6	0.85	2.47	X		
SHOO-0630	MP 282.9	1	2.91	X		
SHOO-0640	MP 283.9	1.95	5.67	X		
SHOO-0650	MP 285.9	2.71	7.88	X		
SHOO-0660	MP 288	0.88	2.56	X		
SHOO-0670	MP 288.9	0.66	1.92	X		
SHOO-0680	MP 290	1.18	3.43	X		
SHOO-0690	MP 291.4	0.37	1.08	X		
SHOO-0700	MP 295.9	2.32	6.75	X		
SHOO-0710	MP 298.1	1.47	4.28	X		
SHOO-0720	MP 299.3	0.59	1.72	X		
SHOO-0730	MP 307.7	0.65	1.89	X		
SHOO-0740	MP 312.8	6.37	18.53	X		
Total:		77.2	224.6			

Notes:

* Based on 24-foot width
MP = mile post

Source: SRK 2013b.

Construction Camps

Mobile and stationary construction camps would be used in locations along the pipeline ROW where construction and facility crews would require temporary housing during construction. Table 2.3-22 lists mainline campsite locations and acreage.

Table 2.3-22: Mainline Pipeline Campsite Locations

Campsite	Approximate Location	Type of Camp/Site Area	Season of Use	
			Summer	Winter
Donlin Gold Camp	Mine Site	TBD	X	X
Kuskokwim West Camp	MP 247	300-Person Camp / 16.3 Acres	X	X
Kuskokwim East Camp	MP 234.8	300-Person Camp / 21.8 Acres	X	X
Big River Camp	MP 192	300-Person Camp / 12.4 Acres		X
Jones Camp	MP 145	300-Person Camp / 30.4 Acres	X	X
Bear Paw Camp	MP 133.4	100-Person Camp / 25.1 Acres	X	
Threemile Camp	MP 111.7	300-Person Camp / 59.6 Acres	X	X
Happy River Camp	MP 85	300-Person Camp / 16.8 Acres		X
Shell Camp	MP 53	300-Person Camp / 42 Acres		X
Deep Creek Camp	MP 42	100-Person Camp / 8.1 Acres (3.3 ha)		X
Beluga Camp	Beluga	TBD	X	X
Total Area:		232.5 Acres		

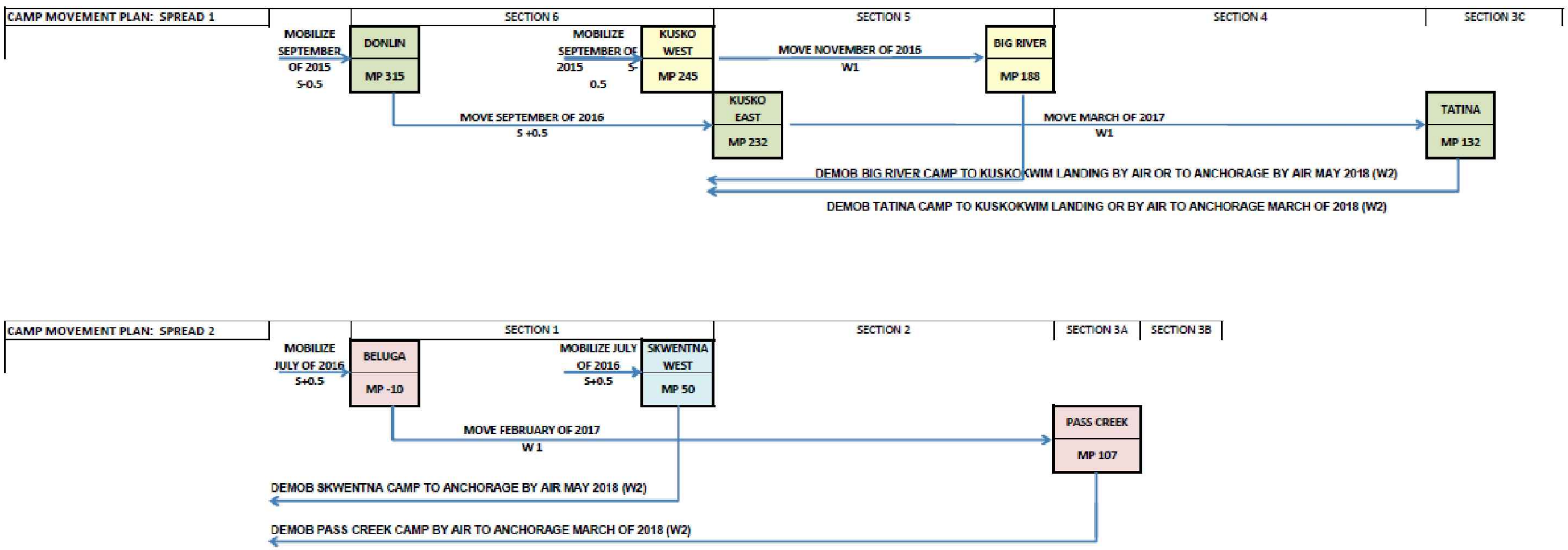
Abbreviations:

MP = milepost

Source: SRK 2013b.

Construction camps would be moved as construction progresses. Of the seven proposed 300-person camps, only four would be active at any given time, to support an active construction spread (Figure 2.3-24). The main campsites would be supplemented by fly-in camps without temporary road access along the ROW, to reduce travel time and commute distance. Camps would be relocated at the end of each construction season in preparation for future construction.

As pipeline construction nears completion, the pipeline construction camps would be demobilized along with the pipeline construction equipment.



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ALTERNATIVE 2
CAMP MOVEMENT PLAN DIAGRAM

NOVEMBER 2015

FIGURE 2.3-24

The main campsites would consist of cleared gravel pads with self-contained, soft- or hard-sided structures. Figure 2.3-25 depicts a typical camp layout. The following facilities would be available at the main construction camps:

- Dormitory units;
- Arctic corridor;
- First Aid unit;
- Recreation center;
- Office modules;
- Kitchen-diner;
- Laundry facility;
- Warehouse / storage (augmented by pipeline contractor as needed);
- Contractor shops (augmented by pipeline contractor as needed);
- Fuel storage and distribution system including storage tanks;
- Water storage;
- Water treatment;
- Sewage treatment;
- Lift stations;
- Generators;
- Parking for equipment and vehicles;
- Communications tower; and
- Water well.

Each 300-person camp would be capable of supporting a workforce of 250, plus maintenance, catering and housekeeping personnel. In addition to serving the living needs of the workforce, the camps would provide administrative space and communication facilities for construction management and inspection teams to conduct their activities.

In addition to the 300-person camps, 30-person camps would be used to support the construction at HDD sites and the construction of the compressor station. These 30-person camps would have the same types of facilities as the other construction camps, but everything would be sized for a maximum of 15 two-person sleeper units. HDD camp site locations are presented in Table 2.3-23.

Table 2.3-23: HDD Camps and Campsite Locations

Name	Approximate Milepost (MP)	Season of Use		
		Summer	Winter	All Season
North Fork George HDD Site				
North Fork George (HDD Entry) 1.4 acres	MP 297.5	X		
North Fork George (HDD Exit) 1.4 acres	MP 298.1	X		
George River HDD Site				
George River (HDD Entry) 1.4 acres	MP 290.5	X		
George River (HDD Exit) 1.4 acres	MP 291.1	X		
East Fork George HDD Site				
East Fork George (HDD Entry) 1.4 acres	MP 282.9	X		
East Fork George (HDD Exit) 1.4 acres	MP 283.8	X		

Table 2.3-23: HDD Camps and Campsite Locations

Name	Approximate Milepost (MP)	Season of Use		
		Summer	Winter	All Season
Kuskokwim River HDD Site				
Kuskokwim River (HDD Entry) 1.4 acres	MP 240.1	X	X	X
Kuskokwim River (HDD Exit) 1.4 acres	MP 241.5	X	X	X
Kusko West Landing	MP 240.7	X		
Kusko East Landing	MP 240.4	X		
Happy River HDD Site				
Happy River (HDD Entry) 1.4 acres	MP 85.7		X	
Happy River (HDD Exit) 1.4 acres	MP 86.4		X	
Skwentna River HDD Site				
Skwentna River (HDD Entry) 1.4 acres	MP 49.9		X	
Skwentna River (HDD Exit) 1.4 acres	MP 50.5		X	
Beluga Landing	MP 10			

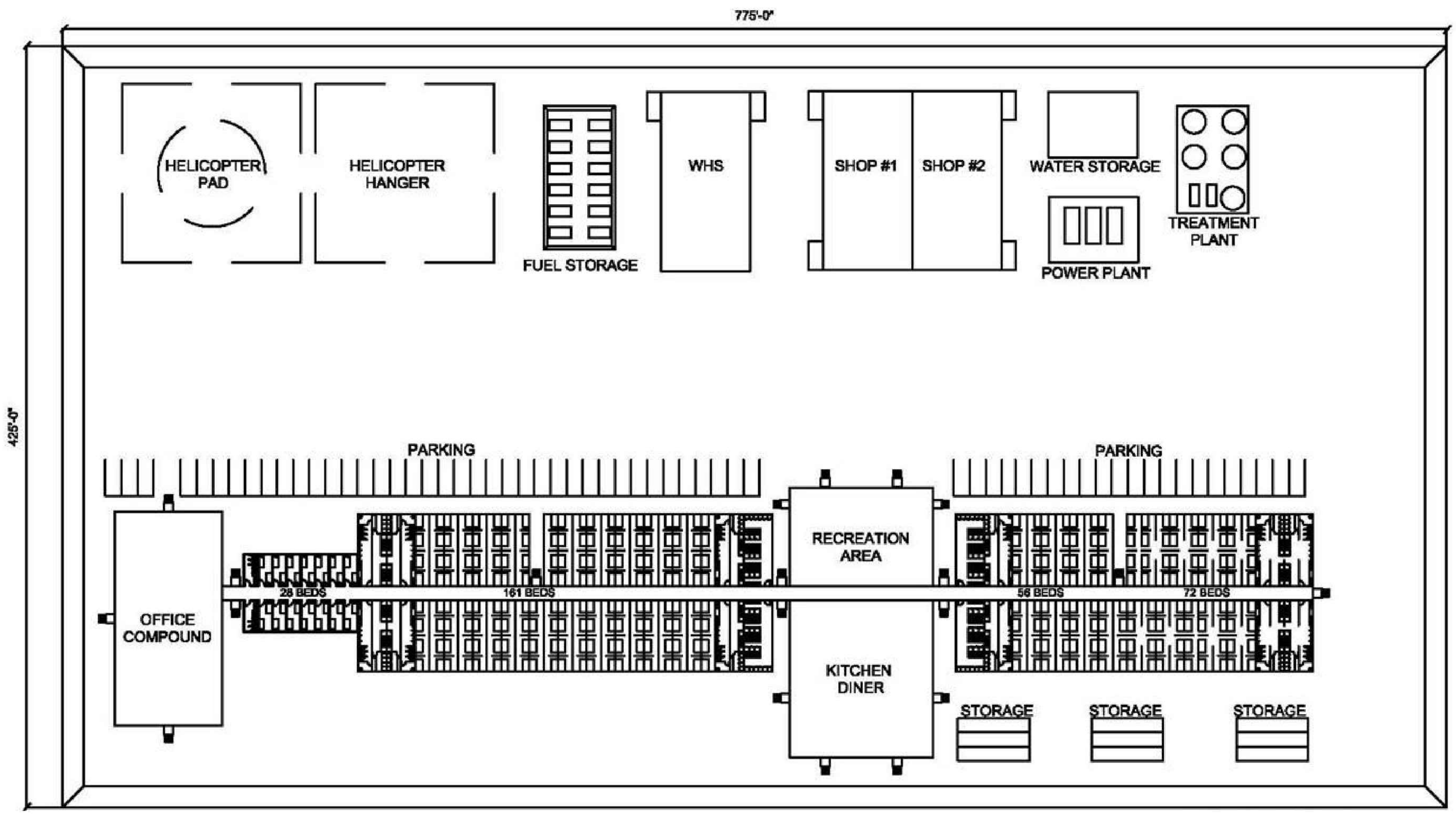
Notes:

HDD = horizontal directional drilling
MP = milepost

Source: SRK 2013b.

All camp waste, including sewage and gray water, would be treated as required and disposed of in accordance with ADEC requirements. General construction waste would be incinerated or shipped offsite; Donlin Gold has not proposed constructing landfills or permitted disposal pits. Hazardous waste would be hauled offsite to approved hazardous waste disposal sites. Used oil from equipment maintenance would be burned on site in approved waste oil unit heaters built for that purpose. In general, the importation of grease, solvents, oils, coolants, hydraulic fluids, and other liquids or chemicals would be controlled to limit the types and amounts of waste generated. Medical hazardous waste would be handled by appropriate medical personnel and disposed of in approved sites. A Comprehensive Waste Management Plan would be developed and followed so that wastes generated by construction activities are minimized, identified, handled, stored, transported, and disposed of in a safe and environmentally responsible manner and in full compliance with applicable state, federal, and local laws and regulations.

The fuel storage facility for pipeline equipment at each camp would be provided and installed by the pipeline construction contractor. The fuel storage facility would store all diesel fuel and gasoline, depending on the specific equipment used, and would be equipped with secondary containment as required by regulations. Primary fuel storage would be located at each camp airstrip because the fuel would be mostly flown in. Table 2.3-24 shows the estimated construction fuel needs.



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ALTERNATIVE 2
GENERAL CONSTRUCTION
CAMP CONFIGURATION

NOVEMBER 2015

FIGURE 2.3-25

Table 2.3-24: Pipeline Construction Fuel Use Estimate

Airstrips	Gallons
Beluga Airstrip	1,000,000
Deep Creek Airstrip	500,000
Shell Airstrip	500,000
Happy River Airstrip	250,000
Threemile Airstrip	500,000
Bear Paw Airstrip	500,000
Jones Airstrip	500,000
Farewell Airstrip	750,000
Big River Airstrip	500,000
Kuskokwim East Airstrip	500,000
Kuskokwim West Airstrip	500,000
Donlin Gold Airstrip	500,000
Total:	6,500,000

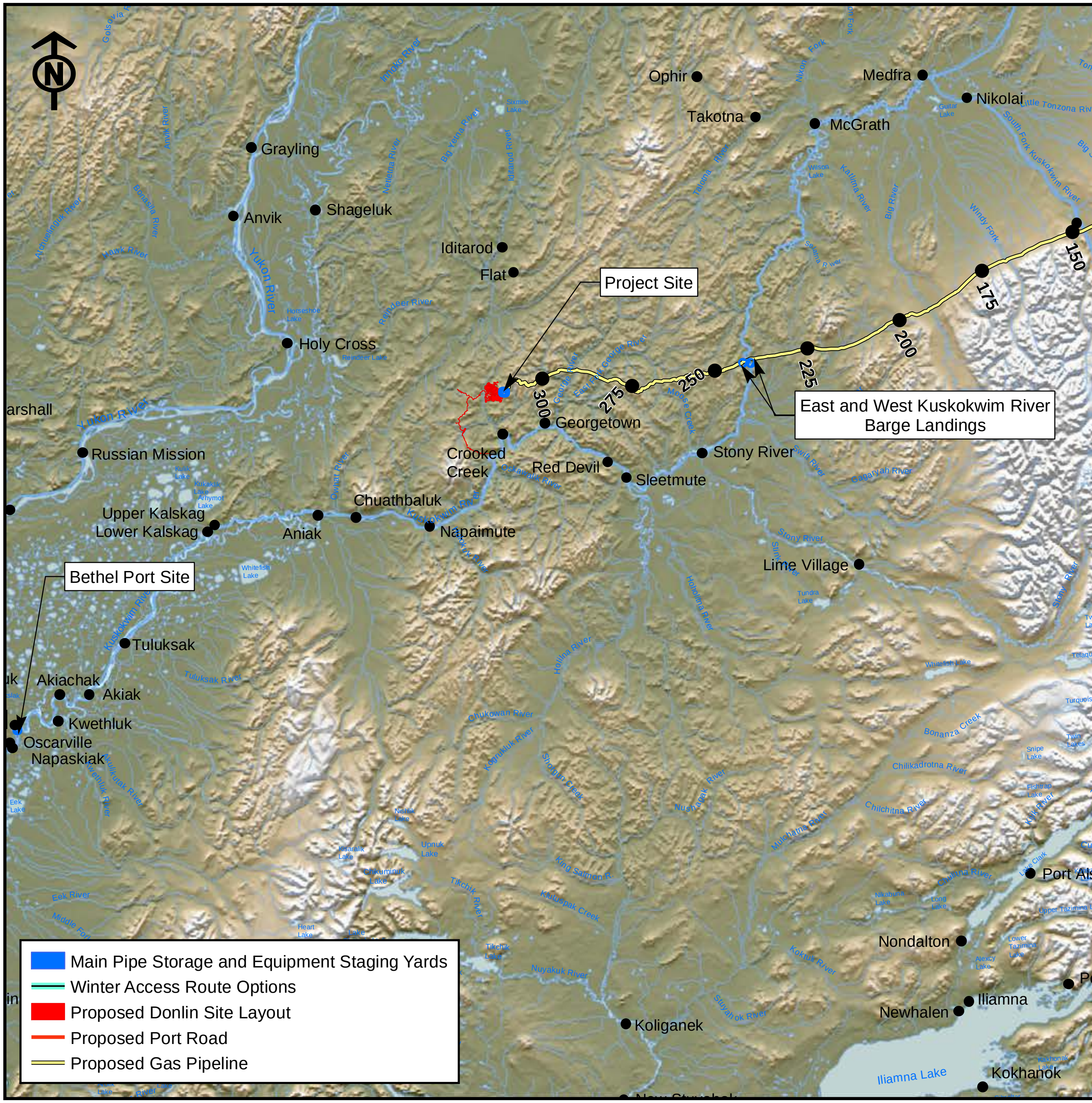
Source: SRK 2013b.

Total fuel needs are estimated at approximately 6,500,000 gallons for pipeline construction, HDD operations, and pipeline camp operations. All fuel handling, transportation, and storage would be conducted in compliance with all applicable regulations. Fuel would be delivered to the storage site by DC6 or Hercules C-130 from bulk fuel suppliers. It would be necessary to keep about 5 to 7 days' fuel supply on hand for at least the camp and essential equipment to allow for road closure or slow deliveries because of weather or road conditions. Fuel would be dispensed to the contractor's fuel trucks for fueling of construction equipment on the ROW or at camp. Pumps at the fuel storage facility can fuel light vehicles and / or on-highway trucks. There would also be a propane storage facility so that contractors can refuel their preheat equipment.

There would be a smaller capacity fuel storage facility closer to camp facilities for diesel generators and / or for heating oil that would be piped to the camps directly, depending on the type of heating system. A gross estimate of this annual fuel consumption would be on the order of 175,000 gallons. The camps may also have their own propane storage tanks for cooking fuel. There would also be small, double-walled tanks with drip liners for helicopter refueling. These would be located at the designated helipad.

Pipe and Equipment Storage Yards

During construction of the pipeline, pipe and equipment would be stored at Bethel, Beluga, the mine site, the Oil Well Road area, and near the barge landing sites on the Kuskokwim River, as shown on Figure 2.3-26. These yards would serve as primary staging points for pipe materials and also for the majority of the heavy equipment required for project construction. They would be used to supply the 57 pipeline storage yards (PSYs), spaced at intervals of approximately 5 miles along the pipeline construction ROW (Table 2.3-25).



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ALTERNATIVE 2
NATURAL GAS PIPELINE
PIPE AND EQUIPMENT YARDS

NOVEMBER 2015

FIGURE 2.3-26

Table 2.3-25: Pipe Storage Yards

Name	Approximate Milepost (MP)	Season of Use			Planned Pipe Source
		Summer	Winter	All Season	
	Beluga Yard*				Beluga
PSY-01	MP 6.8		X		Beluga
PSY-02	MP 12.8		X		Beluga
PSY-03	MP 15.4		X		Beluga
PSY-04	MP 21.8		X		Beluga
PSY-05	MP 28.2		X		Beluga
PSY-06	MP 32.5		X		Beluga
PSY-07	MP 37.5		X		Beluga
PSY-08	MP 42.3		X		Road system then via ice road **
PSY-09	MP 46.7		X		Road system then via ice road **
PSY-10	MP 50.8		X		Road system then via ice road **
PSY-11	MP 54.2		X		Road system then via ice road **
PSY-12	MP 69.8		X		Road system then via ice road **
PSY-13	MP 63.2		X		Road system then via ice road **
PSY-14	MP 68.5		X		Road system then via ice road **
PSY-15	MP 70.8		X		Road system then via ice road **
PSY-16	MP 75.7		X		Road system then via ice road **
PSY-17	MP 79.1		X		Road system then via ice road **
PSY-18	MP 87		X		Road system then via ice road **
PSY-19	MP 90.7		X		Road system then via ice road **
PSY-20	MP 96.8		X		Road system then via ice road **
PSY-21	MP 101.9		X		Road system then via ice road **
PSY-22	MP 106.4		X		Road system then via ice road **
PSY-23	MP 112.2	X	X	X	Road system then via ice road **
PSY-24	MP 114.4	X			Road system then via ice road **
PSY-25	MP 120.6	X			Road system then via ice road **
PSY-26	MP 125.2	X			Road system then via ice road **
PSY-27	MP 132.3	X			Kusko East
PSY-28	MP 138.4	X			Kusko East
PSY-29	MP 142.7	X			Kusko East
PSY-30	MP 148		X		Kusko East

Table 2.3-25: Pipe Storage Yards

Name	Approximate Milepost (MP)	Season of Use			Planned Pipe Source
		Summer	Winter	All Season	
PSY-31	MP 154		X		Kusko East
PSY-32	MP 159.6		X		Kusko East
PSY-33	MP 162.7		X		Kusko East
PSY-34	MP 167.8		X		Kusko East
PSY-35	MP 174.3		X		Kusko East
PSY-36	MP 178.5		X		Kusko East
PSY-37	MP 184.9		X		Kusko East
PSY-38	MP 191.9		X		Kusko East
PSY-39	MP 197.7		X		Kusko East
PSY-40	MP 204.3		X		Kusko East
PSY-41	MP 210.4		X		Kusko East
PSY-42	MP 215.9		X		Kusko East
PSY-43	MP 220.9		X		Kusko East
PSY-44	MP 226.8		X		Kusko West
PSY-45	MP 231.9		X		Kusko West
PSY-46	MP 250.4	X			Kusko West
PSY-47	MP 254.3	X			Kusko West
PSY-48	MP 261.3	X			Donlin Mine
PSY-49	MP 267.9	X			Donlin Mine
PSY-50	MP 271.8	X			Donlin Mine
PSY-51	MP 276.7	X			Donlin Mine
PSY-52	MP 281.6	X			Donlin Mine
PSY-53	MP 284.9	X			Donlin Mine
PSY-54	MP 289.4	X			Donlin Mine
PSY-55	MP 295.4	X			Donlin Mine
PSY-56	MP 302.9	X			Donlin Mine
PSY-57	MP 308.5	X			Donlin Mine

Notes:

* This yard is not laid out; it is assumed there is adequate room at Beluga. Start pipe haul from Beluga.
** Actual winter access route options (Oilwell Road Route or Willow Landing Route) are still being evaluated.

Source: SRK 2013b.

Development of the pipeline storage yards would be initiated during the civil clearing and access season, which would occur generally one year before the pipe-laying season.

Most of the pipeline material and equipment would come through the staging yards located at Beluga and Bethel. There would be 31 PSYs (not counting the Donlin Gold Mine site) in Spread 1 (MP 315 to MP 127), and 26 (not counting Beluga) in Spread 2 (MP 0 to MP 127). These sites would receive and store equipment during periods of no construction between seasons. Each PSY would cover about 1.5 acres, and would be cleared and graded before use. A gravel pad might be installed if the natural soil proved unsuitable. Upon completion of the pipeline construction, the pipeline staging yards would be reclaimed. Stockpiled overburden would be spread on the reclaimed areas to improve soil and facilitate natural revegetation. If gravel is used, the gravel would be left in place when the sites are reclaimed.

Borrow Material Sites

Borrow material sites would be needed to provide gravel fill material for access and shoofly roads; airfields; camp pads; pipeline storage yards; the compressor station and meter pads; and gravel work pads. Material sites would also be the source and location for processing plants for crushed and / or screened material for select backfill; bedding; padding; surface courses; cobbles; rock riprap; and other types of construction material. Table 2.3-26 provides the estimated borrow material source needs for the project. Borrow site boundaries would be shaped to blend with surrounding natural land patterns and each site would be reclaimed consistent with approved, site-specific reclamation plans. The amount of material estimated to be required for the pipeline and ancillary facilities is approximately 2 million cubic yards. Final volumes of these gravel materials and specific location of material sites and development plans for these sites would be part of the final project design.

Table 2.3-26: Estimated Borrow Material Source Needs

Description	Estimated Amount of Material (cy)
Access Roads	700,000-1,000,000
Ancillary Facilities[1]	800,000-1,000,000
Pipeline	55,000
Total:	~2,000,000

Notes:

1 Material source needs for compressor station, pipeline storage yards, MLVs, construction campsites, and airstrips.

cy = cubic yards

Source: SRK 2013b.

Material sites would be located, based on construction material needs, where appropriate materials can be found, and to minimize haul distances. The 70 potential material sites listed in Table 2.3-27 vary in size from 1 to nearly 50 acres and could provide more than sufficient gravel for the project. The location and number of material sites that may require a processing plant / crusher would be determined during final design. Material sites would be located during final design and sized to avoid mapped sensitive areas such as wetlands, cultural sites, sensitive species habitat, and other environmentally sensitive areas.

Table 2.3-27: Potential Material Sites

Material Site	Milepost	Area (acres)	Material Type	Land Status	Est. Available Volume (cy)	Est. Usage (cy)	Season of Use
MS-00	0.0	13.3	Gravel	ANCSA Corporation Land	50,000	30,000	Winter
MS-01	5.1	14.7	Gravel	State Land	75,000	75,000	Winter
MS-02	10.2	14.7	Bedrock	State of Alaska Oil & Gas Leases	20,000	20,000	Winter
MS-03	16.6	5.6	Bedrock	State Land	20,000	20,000	Winter
MS-04	20.1	4.7	Bedrock	State Land	20,000	20,000	Winter
MS-05	26.1	16.5	Gravel	State Land	50,000	50,000	Winter
MS-06	32.5	4.7	Gravel	State Land	20,000	20,000	Winter
MS-07	36.2	3.7	Gravel	State Land	20,000	20,000	Winter
MS-08	42.3	7.0	Gravel	State of Alaska Oil & Gas Leases	150,000	150,000	Winter
MS-09	45	16.1	Gravel	State Land	100,000	50,000	Winter
MS-10	50.5	17.1	Gravel	State Land	20,000	20,000	Winter
MS-11	55.8	36.3	Gravel (alluvial)	State Land	250,000	250,000	Winter
MS-12	68.3	3.6	Gravel	State Land	20,000	20,000	Winter
MS-13	85.3	15.9	Gravel (alluvial)	State Land	100,000	100,000	Winter
MS-14	88	5.2	Gravel (alluvial)	State Land	20,000	20,000	Winter
MS-16	102.9	9.1	Gravel (alluvial)	Miscellaneous	20,000	20,000	Winter
MS-17A	108.4	31.6	Gravel (alluvial)	State Land	250,000	250,000	Winter
MS-17B	112	29.8	Gravel (alluvial)	Miscellaneous	150,000	150,000	All Season
MS-17C	114	19.7	Gravel (alluvial)	State Land	20,000	20,000	Summer
MS-18A	119.9	5.3	Coarse colluvial	State of Alaska Mining Claims	15,000	15,000	Summer
MS-18B	120.3	3.6	Gravel (alluvial)	State Land	15,000	10,000	Summer
MS-18C	121.3	4.6	Gravel (alluvial)	State of Alaska - Permit or Lease	15,000	10,000	Summer
MS-19A	123.3	1.8	Gravel (alluvial)	State of Alaska Mining Claims	15,000	10,000	Summer
MS-19B	124.8	13.4	Coarse colluvial	State Land	25,000	25,000	Summer
MS-20	127	18.5	Gravel (alluvial outwash)	State Land	100,000	50,000	Summer
MS-21	130.3	26.5	Bedrock and Gravel (alluvial)	State Land	100,000	50,000	Summer
MS-22	133.7	21.5	Gravel (alluvial)	State Land	100,000	100,000	Summer

Table 2.3-27: Potential Material Sites

Material Site	Milepost	Area (acres)	Material Type	Land Status	Est. Available Volume (cy)	Est. Usage (cy)	Season of Use
MS-23	138.5	14.6	Gravel (glacial/ alluvial)	State Land	50,000	20,000	Summer
MS-24	144.9	20.6	Gravel (alluvial)	State Land	250,000	150,000	All Season
MS-25	147.5	42.9	Gravel (alluvial)	Rights-of-Way & Easements	1,000,000	15,000	Winter
MS-26	161.5	7.4	Gravel (alluvial)	State Land	1,000,000	150,000	Winter
MS-27	156.5	11	Gravel	ANCSA Corporation Land	250,000	200,000	Winter
MS-27A	159.6	3.3	Gravel (alluvial)	State Land	100,000	100,000	Winter
MS-28	160.8	7.4	Gravel	State Land	200,000	30,000	Winter
MS-28A	162.7	8.9	Gravel (alluvial)	State Land	200,000	75,000	Winter
MS-29	164.2	7.4	Gravel	State Land	200,000	45,000	Winter
MS-30	168.2	14	Gravel	State Land	250,000	125,000	Winter
MS-31	170.8	7.5	Gravel	State Land	200,000	80,000	Winter
MS-32	174.2.0	11.1	Gravel	Federal (BLM) Land	250,000	100,000	Winter
MS-33	176.7	6.5	Gravel	Federal (BLM) Land	100,000	60,000	Winter
MS-34	178.9	5	Gravel	State Land	75,000	50,000	Winter
MS-35	182.9	13.5	Gravel	State Land	300,000	110,000	Winter
MS-36	184.9	6.9	Gravel	Federal (BLM) Land	100,000	100,000	Winter
MS-38	190.9	5.2	Gravel	Federal (BLM) Land	150,000	150,000	Winter
MS-39	191.8	7.4	Gravel	Federal (BLM) Land	150,000	150,000	Winter
MS-40	198	18.7	Gravel	Federal (BLM) Land	150,000	135,000	Winter
MS-41	204.8	11.6	Gravel	Federal (BLM) Land	100,000	90,000	Winter
MS-42	213.2	39.5	Bedrock	State Land	1,000,000	350,000	Winter
MS-43	216.8	7.8	Bedrock	State Land	75,000	75,000	Winter
MS-44	222.4	43.5	Bedrock	State Land	1,00,000	150,000	Winter
MS-45	225.9	24	Bedrock	State Land	500,000	240,000	Winter
MS-46	229.9	19.6	Bedrock	Federal (BLM) Land	250,000	120,000	Winter
MS-47	231.9	18.5	Bedrock	Federal (BLM) Land	150,000	60,000	Winter
MS-48	234.9	61.8	Bedrock	Federal (BLM) Land	250,000	100,000	All Season
MS-49	235.6	15.5	Bedrock	Federal (BLM) Land	150,000	150,000	All Season
MS-50	239.4	25.6	Bedrock	State Land	200,000	200,000	All Season

Table 2.3-27: Potential Material Sites

Material Site	Milepost	Area (acres)	Material Type	Land Status	Est. Available Volume (cy)	Est. Usage (cy)	Season of Use
MS-52	241	48.6	Bedrock & Gravel	State Land	1,000,000	250,000	All Season
MS-53	243.4	23.5	Bedrock	State Land	150,000	120,000	All Season
MS-54	247	32.9	Bedrock	State Land	500,000	300,000	All Season
MS-55	254.7	3.7	Bedrock	Federal (BLM) Land	50,000	25,000	Summer
MS-56	256.8	3.3	Bedrock	State Land	50,000	25,000	Summer
MS-57	264.2	3.7	Bedrock	Federal (BLM) Land	50,000	25,000	Summer
MS-58	269.2	3.7	Bedrock	Federal (BLM) Land	50,000	25,000	Summer
MS-59	281.5	13	Bedrock	Federal (BLM) Land	200,000	50,000	Summer
MS-60	284.7	15	Bedrock	Federal (BLM) Land	200,000	50,000	Summer
MS-60A	284	9.9	Bedrock	Federal (BLM) Land	200,000	50,000	Summer
MS-61	290.4	11.6	Bedrock	Federal (BLM) Land	200,000	50,000	Summer
MS-61A	291.4	4.7	Bedrock	Federal (BLM) Land	50,000	50,000	Summer
MS-62	293.9	21.3	Bedrock	Federal (BLM) Land	300,000	100,000	Summer
MS-63	298.8	10.0	Bedrock	Federal (BLM) Land	200,000	200,000	Summer
Total:		1,056.1			13,360,250	6,270,000	

Notes:

cy = cubic yards
MS = material site

Source: SRK 2013b.

Airstrips

Twelve airstrips would be used to support pipeline construction logistics; nine of these would be new (Table 2.3-28). Figure 2.3-27 provides the locations of the existing and proposed airstrips. Specific siting of the airstrips was conducted to reduce cut-and-fill required to create the runway surface. Existing airstrips would be used at three locations, although some would require upgrading to meet the Donlin Gold Project's needs. Public airstrips would require authorization or concurrence from USDOT and the Federal Aviation Administration prior to use. Also, authorization from the landowner to use existing airstrips will need to be verified. All twelve airstrips would require storage for air operations and staging areas for pipeline construction materials. Actual facilities and area requirements for each airstrip would be determined during final design. Table 2.3-29 provides an estimate of the number of rotary and fixed wing aircraft trips needed during pipeline construction and operations.

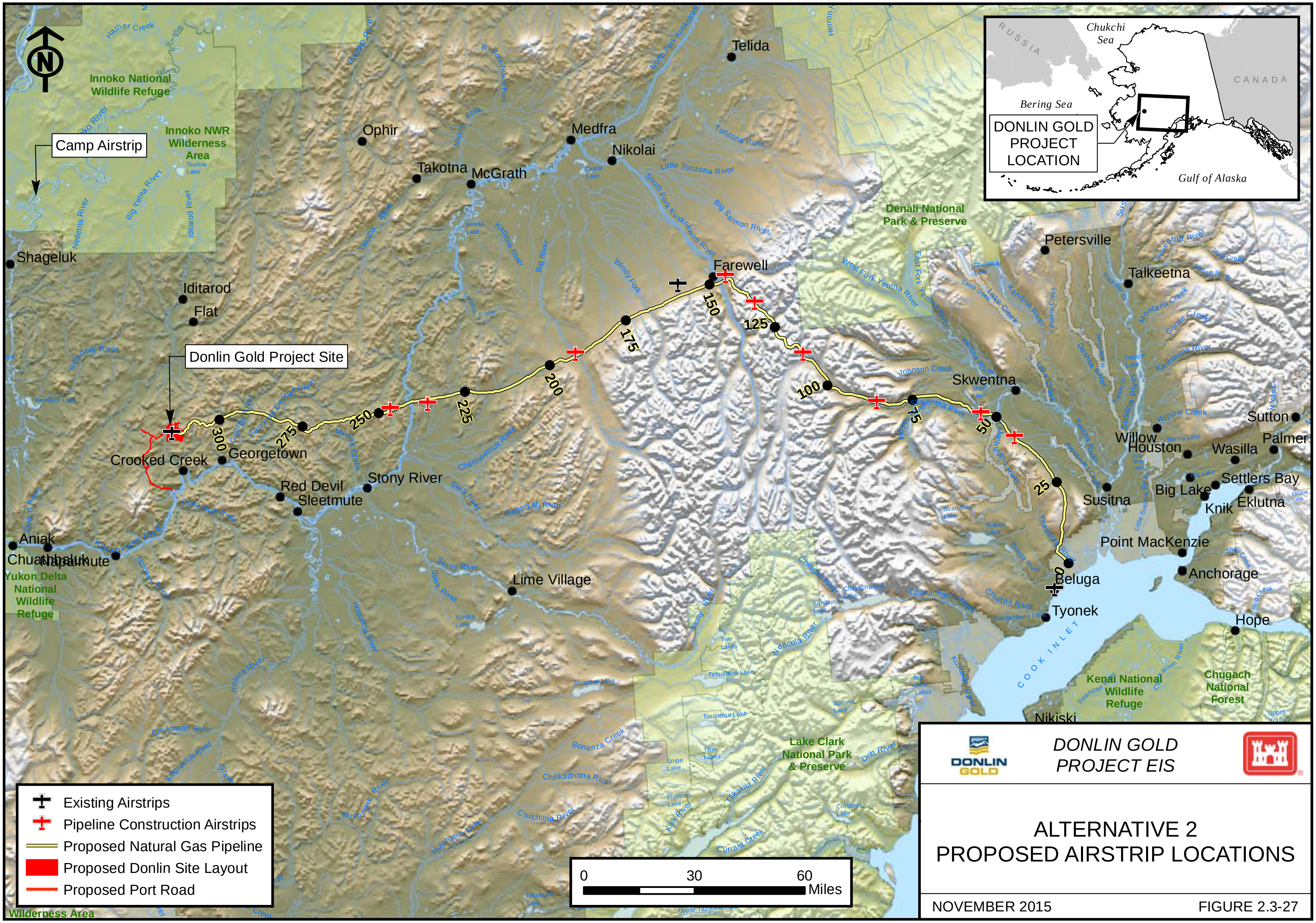
Table 2.3-28: Airstrip Locations and Construction

Name	Approx. Milepost (MP)	Length (ft/m)	Land Status	Construction/Area	Season of Use		
					Summer	Winter	All Season
Beluga Airstrip	Beluga	5,000 ft	ANCSA Corporation Selections and Conveyances	Existing – No work	X	X	X
Deep Creek Airstrip	MP 42.1	3,500 ft	State Land	New – Grade, cut and fill 19.4 acres		X	
Shell Airstrip	MP 54	5,000 ft	State Land	New – Grade, cut and fill 103.7 acres		X	
Happy River Airstrip	MP 85.1	5,000 ft	Miscellaneous	New – Grade, cut and fill 86.7 acres		X	
Threemile Airstrip	MP 111.8	3,500 ft	State Land	New – Grade, cut and fill 27.9 acres	X	X	X
Bear Paw Airstrip	MP 133.8	4,000 ft	State Land	New – Grade, cut and fill 26.8 acres	X		
Jones Airstrip	MP 144.9	5,000 ft	State Land	New – Grade only, floodplain 84.3 acres	X	X	X
Farewell Airstrip	MP 158.2	5,000 ft	Federal Land	Existing – Grade only, surface course 139.9 acres	X	X	X
Big River Airstrip	MP 191.6	5,000 ft	Federal Land	New – Grade, cut and fill 62.3 acres		X	
Kuskokwim East Airstrip	MP 235.7	5,000 ft	State Land	New – Grade only, 59.3 acres	X	X	X
Kuskokwim West Airstrip	MP 246.2	5,000 ft	State Land	New – Grade only, 63 acres	X	X	X
Donlin Gold Airstrip	Donlin Gold Camp	5,000 ft	ANCSA Corporation Selections and Conveyances	Existing – No work	X	X	X
Total Area:				673 Acres			

Notes:

ft = feet
MP = milepost

Source: SRK 2013b.



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ALTERNATIVE 2
PROPOSED AIRSTRIP LOCATIONS

NOVEMBER 2015

FIGURE 2.3-27

Table 2.3-29: Air Operation Estimates

		Rotary Wing Aircraft														Fixed Wing Aircraft		
				Helicopter Flights per Month												Fixed Wing Demand		
Area	Phase	Aircraft	Per Year	J	F	M	A	M	J	J	A	S	O	N	D	Dash 8 Q300*	Twin Otter Series 400*	Cargo Plane (Type TBD)*
Pipeline	Construction	2 helicopters per spread = 4 TOTAL	1,187	124	112	124	120	62	120	124	124	60	62	62	93	1 flight per day per spread	1 flight per day per spread	1 flight per day per spread
			Trips along the ROW alignment to and from camps: maximum 1-way = 50 miles average 1-way = 25 miles															
	Operations	1	24	2	2	2	2	2	2	2	2	2	2	2	2	None	1 flight / week Anchorage - Beluga	None

Source: SRK 2013b.

2.3.2.3.5 PIPELINE – DESIGN AND CONSTRUCTION PROCEDURES

The proposed pipeline facilities would be designed, constructed, operated, and maintained in accordance with USDOT regulations under 49 CFR Part 192, Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards, and other applicable federal and state regulations. Among other design standards, these regulations specify pipeline material selection; minimum design requirements; protection from internal, external, and atmospheric corrosion; and qualification procedures for welders and operations personnel.

Pipeline – Design and Wall Thickness

The 14-inch (outside diameter) pipe would have a pipe wall thickness between 0.25 inches and 0.406 inches. In areas where geotechnical hazards exist, such as occurs during thaw settlement and frost heave, pipe with 0.344-inch or 0.375-inch walls would be used. Pipe to be laid in areas requiring additional strength during pressure testing because of large elevation changes, or requiring buoyancy control in wetlands, would have 0.375-inch thick pipe wall. In areas with HDD installations, above-ground fault crossings and other high-hazard areas, pipe with 0.406-inch thick walls would be installed.

Pipeline – Delivery of Construction Materials and Equipment

Materials and equipment delivered to Bethel on ocean-capable barges would be temporarily offloaded to the storage yard in Bethel for later transfer to shallow-draft barges capable of transporting loads up the Kuskokwim River to the barge landing / material storage sites on each bank of the river (Kuskokwim East and West) and to the Angyaruaq (Jungjuk) Port. Pipe would be delivered to the Port of Anchorage, and barged to a storage yard at Beluga or sent overland to Oilwell Road / Willow Landing (depending on final access decisions). Pipe and other materials delivered to Beluga would be transported by truck on the existing Beluga area road system to the beginning of the ROW; and then to endpoints of delivery along the route. For construction, pipe would be delivered by truck to 57 intermediate PSYs spaced along the ROW at 5-mile intervals (see Table 2.3-25 Pipe Storage Yards).

Pipeline – Standard Construction Procedures

Pipeline components include: the pipeline; compressor station; metering stations; pig launching and receiving facilities; and temporary facilities that would be used for construction such as material sites; access roads; work pads; airfields; and construction camps. Pipeline construction efforts would also require an electric transmission line from Beluga to the compressor station and installation of a fiber optic cable. Because of the lack of developed access infrastructure and because of soft and wet soil conditions, construction would occur primarily during winter, under the frozen conditions needed to support equipment and limit environmental impacts. To address the technical aspects presented by varying terrain, seasonal conditions, and overall remoteness of the proposed pipeline project, a pipeline construction sequence and schedule has been developed by construction spread. This is a feasibility level construction plan and will be modified and updated as needed during final design.

Pipeline construction would be divided into two spreads: Spread 1 would be 188.6 miles long and would operate on the west side of the project from the Tatina River crossing at approximately MP 127 in the Alaska Range to the mine site; Spread 2 would be 126.6 miles long and would operate from MP 127 to the beginning of the pipeline at the tie-in point at MP 0.

Construction practices would be tailored for the installation season. The prevalence of low grade wetlands and/or permafrost on each side of the Alaska Range dictate winter construction for about 68 percent of the approximately 315 miles of pipeline.

Winter construction is planned for the following areas:

- MP 0 to MP 111.6
- MP 144.4 to MP 247.6

Summer construction is planned for the following areas:

- MP 116 to MP 144.4 (major stream crossings may be completed during the shoulder season or winter)
- MP 247.6 and MP 315.2

The overall construction schedule would span approximately 3 years; with the first year including ROW civil work and mobilization of materials and equipment (see Table 2.3-30).

The construction plan and execution sequence would include: ROW clearing and grading of access roads; construction of shoofly roads where the ROW is too steep for transport of pipe and cathodic protection materials; preparation of compressor station site and campsites; camp construction; pipeline storage yard construction; airstrip upgrades; and barge landings as well as material site development and access roads. Table 2.3-30 identifies the planned MP section and planned construction season dates.

The majority of the proposed pipeline construction process would be accomplished using conventional open cut methods. The overland installation of the pipeline is best represented as a moving assembly line with a construction spread (crew and equipment) proceeding along the construction ROW in continuous operation as shown on Figure 2.3-28. The length of time a trench would remain open (i.e., trenching to backfill) during construction at any given location along the route would typically range from 1 to 3 days, while total construction efforts at any single point, from ROW surveying and clearing, to backfill and finish grading, would last 3 to 4 months.

Before initiating clearing, the ROW would be staked and flagged, using a standard construction color code system. The staking would mark the centerline, edge of working construction ROW, and additional temporary workspace to clearly delineate the area approved and authorized for construction disturbance. Staking would reflect any ROW grant or permit stipulations to avoid or minimize impacts to sensitive environmental areas such as wetlands or cultural resources.

The construction ROW and work areas would be cleared and graded, where necessary, to provide a relatively level surface for trench-excavating equipment and the movement of other construction equipment. Brush, trees, roots, and other obstructions such as large rocks and stumps would be cleared from all construction work areas. Stumps would be removed from the proposed construction ROW. Work pads would be installed to provide a level work surface during construction. Snow/ice, gravel, and/or graded work pads would be installed after clearing and grading.

Table 2.3-30: Pipeline Construction Execution Sequence

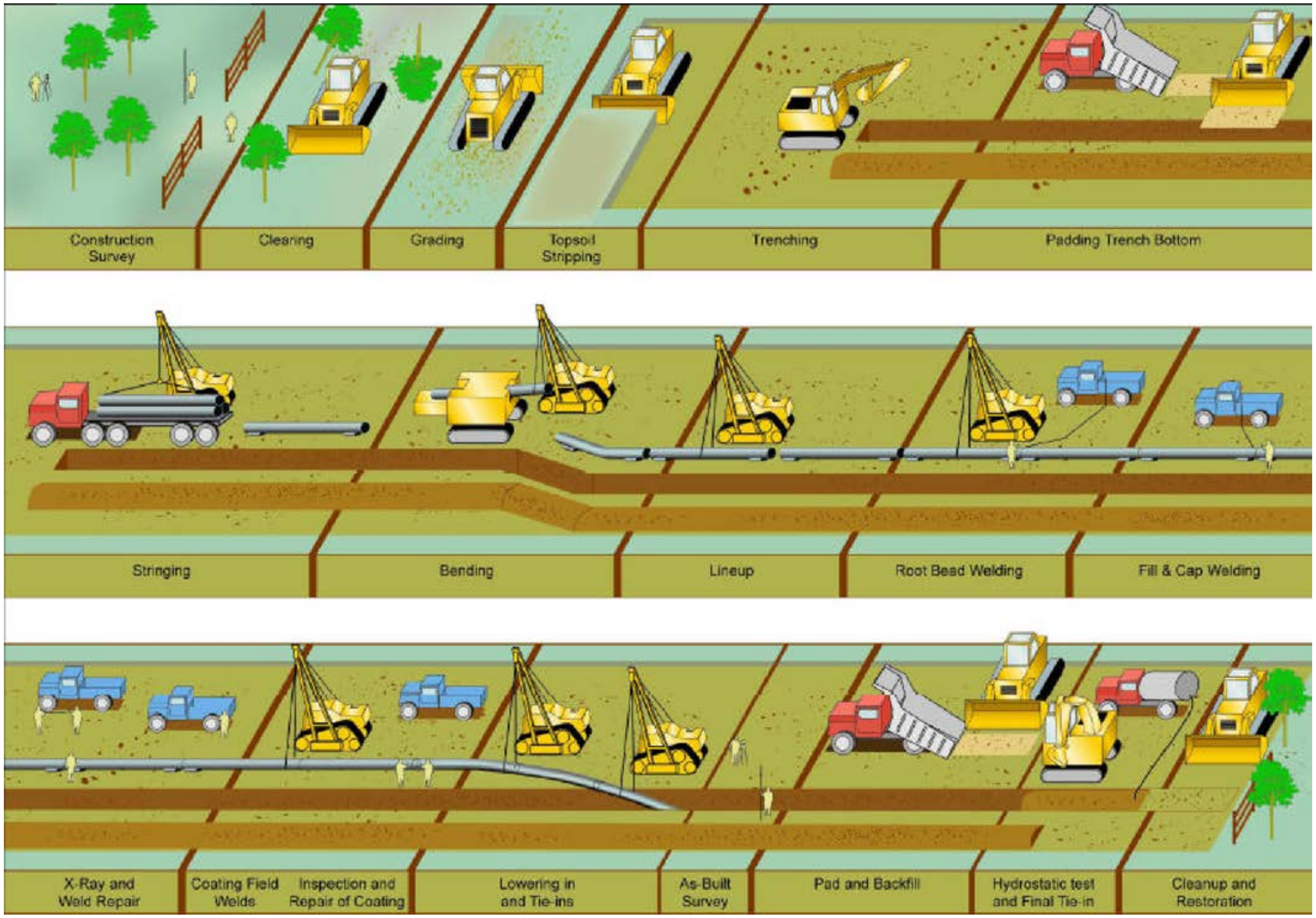
Spread	Season	From Milepost	To Milepost	Length (miles)	ROW Work Start	Pipe Lay Start	Pipe Lay Complete	End of Season
1	Summer 0.5	315.2	247.6	67.6	July – Mine Site	August	October	November – Alpine Ridge
	Winter 1	247	196.6	51	Nov. – Alpine	January	March	April – Big River
	Summer 1.5	144.4	126.6	17.8	May – S. Fork Kusko River	July	August	September – Tatina River
	Winter 2	144.4	196.6	52.2	Nov. – S. Fork Kusko River	January	March	April – Big River
Subtotal:				188.6				
2	Winter 1	0.0	50.8	50.8	Nov. – Beluga	January	March	April – Skwentna River
	Winter 1	101.8	111.6	9.8	March – Puntilla :Lake	March	April	April – Threemile Creek
	Summer 1.5	111.6	126.6	15	June – Threemile Creek	July	August	September – Tatina River
	Winter 2	101.8	5.08	51	Nov. – Puntilla Lake	January	March	April – Skwentna River
Subtotal:				126.6				

Notes:

Pipeline mobilization is scheduled for S-05 and pipeline commissioning is scheduled for S-2.5. Preliminary Civil Construction of access roads, airstrips, barge landings, pipe storage yards, campsites, etc., begins in W-0, one year before the first winter of pipeline construction.

Daily pipe lay rate (in linear feet) and pipe lay duration (in number of days) for each construction section would be estimated during final design.

Source: SRK 2013b.



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TYPICAL PIPELINE CONSTRUCTION SEQUENCE

NOVEMBER 2015

FIGURE 2.3-28

Standard Trenching Procedures

The pipeline would be buried below the ground surface to a depth that would meet or exceed USDOT standards at 49 CFR 192.327. The minimum depth of cover for the pipeline, in accordance with 49 CFR Part 192, is between 18 and 48 inches (see Table 2.3-31).

Table 2.3-31: Minimum Cover Requirements

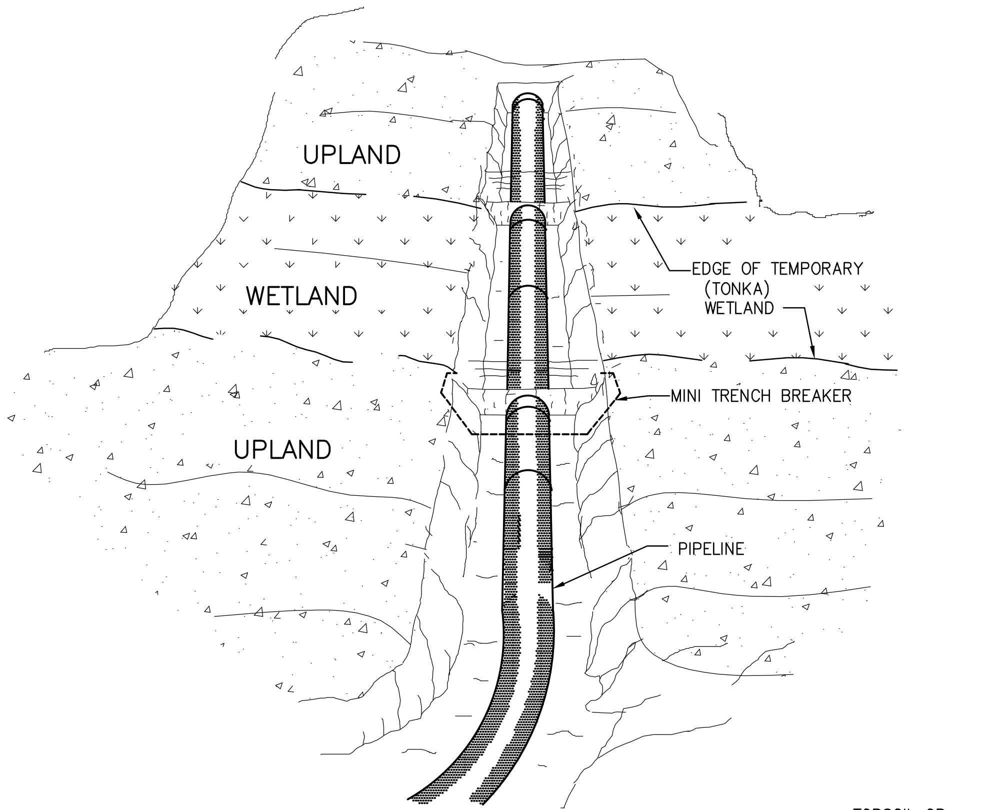
Pipeline area	Minimum Cover (inches)	
	Soil Trench	Rock Trench
Standard trench	30	18
Drainage or ephemeral waterways	48	24

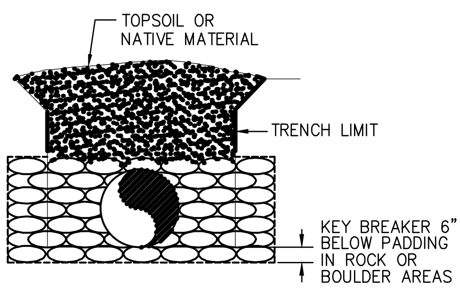
Source: SRK 2013b

The actual installation depth of the pipeline would vary, ranging from the minimum depth requirements to the depth required for safe crossing of a feature such as a water body. Final design depth would be based on detailed site evaluations.

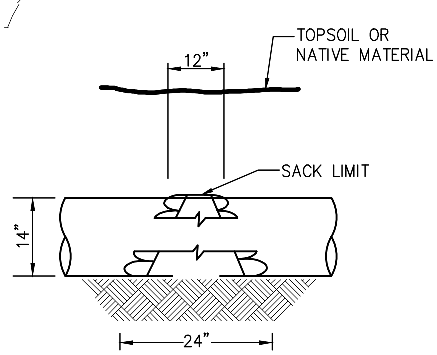
The pipeline would be buried in trenches or through HDD. The latter is generally used on major river crossings or in locations where the pipeline would cross waters that support high-value or sensitive fish habitats, and in geological hazard areas where trenching is not feasible because of unstable slopes. A trench would be excavated using chain excavators, wheel trenchers, and/or backhoes. Trenching crews would excavate a trench deep enough to provide the design soil cover depth over the top of the pipe. Construction methods used to excavate the trench would vary, depending on soil type and terrain. Excavators would generally be used in areas of steep slopes, high water table, soils with cobbles and boulders, or deep trench areas such as river and stream crossings.

Excavated materials would normally be stored on the spoil side of the trench, away from construction traffic and pipe assembly areas. Subsoil would not be stored in flowing water bodies, dry drainages, or washes that cross the ROW. Subsoil would be placed on the banks of the drainage in such a manner as to prevent sedimentation from occurring, or placed in another location. "In areas where significant organic surface mat is present, efforts would be made to separate this material from mineral soils during excavation of the trench and to stockpile it separately for use in final cover and reclamation of the trench line after pipe installation" (SRK 2013b). Where required, temporary mini trench breakers or barriers would be used to create segments within the open trench to reduce erosion, as shown on Figure 2.3-29. Trench breakers would typically consist of polyurethane foam, sandbags and/or gravel placed across the ditch. Trench dewatering may also be required along portions of the route.





CROSS SECTION



SIDE VIEW

NOTES:

1. MINI-TRENCH BREAKERS SHALL BE INSTALLED AT EDGE OF EACH TEMPORARY (TONKA) WETLAND.
2. OPEN WEAVE HEMP OR JUTE SACKS SHALL BE FILLED WITH A MINIMUM OF 55lbs. OF SAND OR SUBSOIL.
3. BREAKER CONFIGURATION MAY BE CHANGED TO INCLUDE KEYING AS DETERMINED BY COMPANY ENGINEER.

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ALTERNATIVE 2
TYPICAL TRENCH BARRIER

NOVEMBER 2015 FIGURE 2.3-29

Standard Pipe Stringing, Bending, Welding, and Inspecting

Sections of 60-foot pipe would be delivered in straight sections. The straight sections of pipe would be temporarily placed or "strung" along the excavated pipeline trench, where they would be bent as necessary to follow the natural grade and direction changes of the ROW. Stringing operations would be coordinated with all other installation activities to ensure that the pipe is available for bending, welding, and lowering-in to minimize the amount of time the trench is open. The intent would be to close the trench as soon as practical. The pipeline construction plan calls for minimization of open trenches for construction purposes. The more time a trench is open, the higher the chance of the trench filling with snow and having to remove snow. Following stringing and bending, the ends of the pipeline would be carefully aligned and girth-welded together. The girth welds would be visually inspected and tested to ensure their structural integrity, using non-destructive examination methods such as radiography (x-ray), gamma ray, or ultrasound. Those girth welds that do not meet established specifications would be repaired or replaced.

Because much of this project would be constructed in winter, the contractor may elect to trench after the pipe is strung. This would mean that the trench would have to be dug to fit the bent pipe. The bending engineer would work off the profiles and plans on the alignment sheets and would survey the original ground. From that information and knowing the intended depth of cover, the bending engineer can calculate the bends. The trenching crew would make sure that sags, overbends, sidebends, and combinations are dug to match the pipe.

Standard Lowering-In and Backfilling

To prevent corrosion, the majority of the pipe would be externally coated with a three-layer polyethylene coating before delivery. Following welding, the previously uncoated ends of the pipe, at all joints, would be coated with polyethylene-compatible material in preparation for installation. The coating on the remainder of the completed pipe section would be inspected for defects, and any damaged areas would be repaired prior to lowering the pipe into the trench. At locations with saturated soils, the pipeline would be coated with concrete, bolt-on river weights, or saddle bags to provide negative buoyancy, if required.

Before the pipe section is lowered into the trench, inspection would be conducted to verify that the trench bottom is free of rocks and other debris that could damage the external pipe coating. Dewatering may be necessary where water has accumulated in the trench. This would occur in accordance with permit requirements. Sideboom tractors would be used to lift the pipe, position it over the trench, and lower it into place. Specialized padding (soil screening equipment) machines may be used to screen previously excavated mineral soils to provide a padding and bedding material free of larger material (>1 inch in size) to line the bottom of the trench before lowering-in pipe, and to provide backfill material next to the sides and the top of the pipe that would not damage the pipe coating. The coating would be inspected again just before the pipe is placed in the trench.

<u>Pipeline – Site-Specific Construction Procedures</u>

Certain locations along the ROW will require specialized construction techniques for crossing water bodies or fault lines, and in areas of permafrost or steep terrain.

Water Body and Wetland Crossings

Pipeline stream crossings would be accomplished using one of the following or similar crossing methods: HDD, open cut, dry flume, open cut dam and pump, flowing water open cut, non-flowing water open cut, or small creek crossing. Typical winter crossings of water courses where there is no surface flow would be by open cut. Where feasible, the crossing would be open cut; otherwise, the crossing would be achieved by HDD based on the evaluation criteria below. Smaller drainages would be installed by open cut, where practical.

Construction effects on fish and fish habitat areas would be minimized by selecting stream crossing techniques that provide the appropriate level of protection for the specific habitat sensitivity. In-water work windows would be used to minimize effects on fishery resources during sensitive life-cycle stages. Appropriate stream bank rehabilitation and reclamation techniques and BMPs would be used.

Installation techniques used to cross water courses are described below and would depend on the season of crossing, terrain, geotechnical and environmental conditions, the presence of fish resources, and engineering needs. Each stream crossing would be conducted in a manner and during a time period that avoids or minimizes potential fishery effects.

There are a number of stream-crossing techniques that can be used to protect fishery resources during sensitive periods. These techniques attempt to isolate the in-water work area from the flowing water of the stream being crossed and include the measures listed below.

- HDD beneath large rivers and critical fish habitat
- Damming and pumping streams around crossing sites
- Diverting streams to dewater crossing sites
- Crossing when streams are completely frozen
- Fluming streams through temporary culverts and placing the pipeline beneath the culverts
- Surveying for fish overwintering areas and avoidance of these locations.

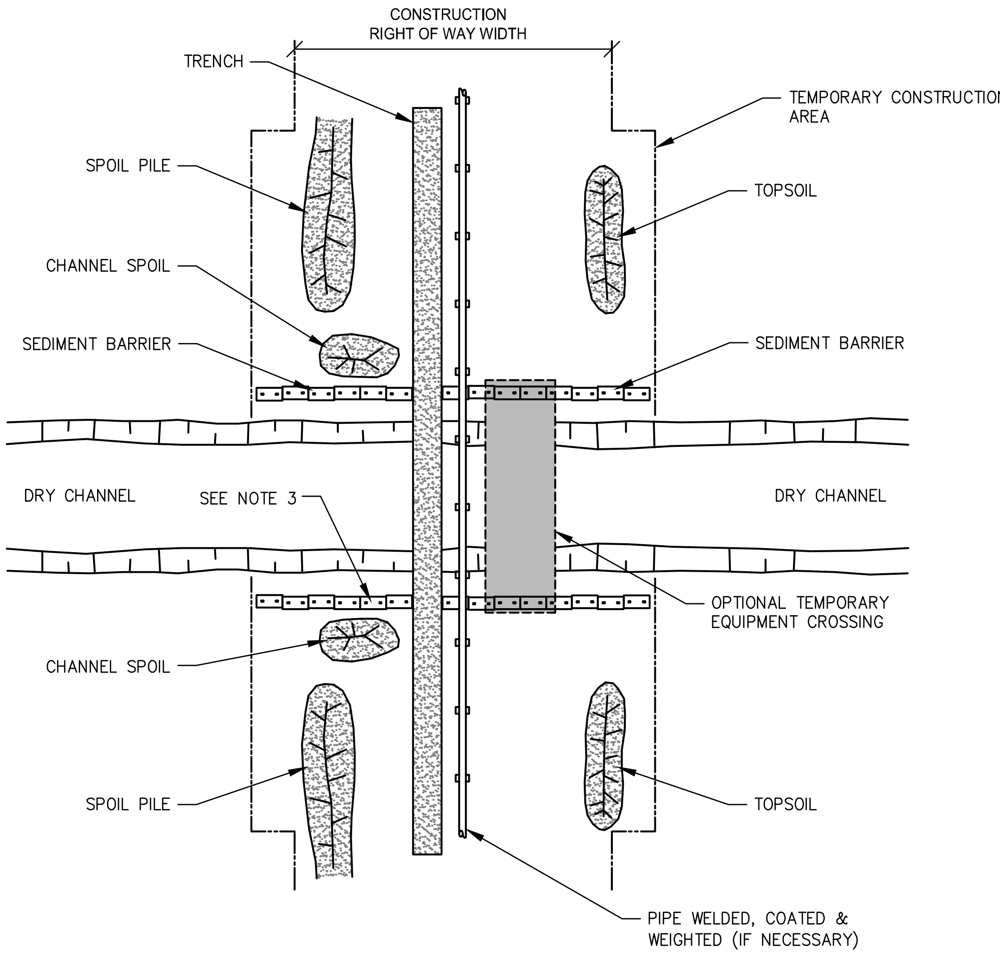
The method of crossing would be determined during final design and confirmed at the time of construction.

Open Cut Method

Typical winter crossings of water courses where there is no surface flow would be by open cut. A typical, non-flowing, open-cut water body crossing is shown on Figure 2.3-30.

In general, the open cut method would be used for three different types of water bodies. This would be the preferred method for the crossing of the following:

- Intermittent streams, ditches, and non-sensitive water bodies where sedimentation is not a significant factor.
- Frozen rivers or streams in winter that have no surface flow. A large number of streams that would be crossed in winter will fit this category. Even a river as large as the Big River may be frozen solid in February.



PLAN VIEW
NOT TO SCALE

NOTES:

1. METHOD APPLIES TO CROSSING WHERE NO FLOWING WATER IS PRESENT AT THE TIME OF CROSSING.
2. CONTRACTOR MAY "MAINLINE THROUGH" THE CROSSING OR UP TO BOTH SIDES OF THE CROSSING; STRING, WELD, COAT, AND WEIGHT (IF NECESSARY), USING THE MAINLINE CREW WITH THE PIPE SKIDDED OVER THE CROSSING.
3. CONSTRUCT SEDIMENT BARRIERS ACROSS THE ENTIRE CONSTRUCTION R.O.W. FOLLOWING CLEARING AND GRADING AND MAINTAIN UNTIL CONSTRUCTION OF THE CROSSING. EROSION CONTROL MEASURES SHALL BE REINSTALLED IMMEDIATELY FOLLOWING BACKFILLING OF TRENCH AND STABILIZATION OF BANKS.
4. TOPSOIL AND SPOIL WILL NOT BE STOCKPILED IN THE CROSSING CHANNEL.
5. MAINTAIN STREAM FLOW THROUGHOUT CROSSING CONSTRUCTION.
6. BACKFILL WITH NATIVE MATERIAL.
7. RESTORE CROSSING CHANNEL TO APPROXIMATE PRE–CONSTRUCTION PROFILE AND SUBSTRATE.
8. RESTORE CROSSING BANKS TO APPROXIMATE ORIGINAL CONDITION AND STABILIZE, AS REQUIRED.

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ALTERNATIVE 2
TYPICAL NON FLOWING OPEN CUT WATER BODY CROSSING

NOVEMBER 2015

FIGURE 2.3-30

- Streams and rivers so large that no isolation method can be used. The open cut method would be preferred for larger streams and rivers, depending on several factors including the crossing season, flow volume, water velocity, type of bed material or substrate, width, depth, amount of cover, type, and extent of buoyancy control.
  - The South Fork of the Kuskokwim River would be a winter open cut and the Tatina River would be open cut during the July-August time frame.
  - The crossings of the Big River, the Middle Fork of the Kuskokwim River, Windy Fork, Sheep Creek, and Tatlawiksuk River would be by winter open cut.
  - For larger rivers, the trench would be excavated through the water body, using backhoes operating from the banks, or within the water body if it is too wide. For wide, braided rivers, backhoe operators would have to install some channel diversion to provide safe work access. Spoil from intermittent streams, trenches, and non-sensitive water bodies would be placed at least 10 feet from the water's edge on the construction ROW or in the extra workspace. The spoil would be contained as necessary by silt fence to minimize sediment movement. A tie-in crew would be used to execute open cuts on intermittent or small streams.
  - For water bodies other than non-flowing streams or drainage ditches, a trench plug would be left between the upland trench and the in-stream activities to prevent diversion of water into upland portions of the pipeline trench and to keep accumulated trench water out of the water body. The trench plug would be removed to allow installation of pipe.

Dam-and-Pump Method

The dam-and-pump method is a dry crossing method that is suitable for low-flow streams that have a streambed contour suitable for dam installation. The dam-and-pump method has severe limitations for use in winter because discharge hoses would freeze; reducing, or shutting down pump output.

The dam-and-pump method involves damming the stream with sandbags or water bladders upstream and downstream of the proposed crossing before excavation and pumping water around the construction area. Pumping the water body across the ROW would begin simultaneously with dam construction to prevent interruption of downstream flow. Water body flow would be pumped across the construction area through hoses and discharged onto an energy-dissipation device where required to prevent scouring of the streambed.

Some streams or rivers that have low flows in the winter are candidates for dam-and-pump. No specific dam-and-pump crossings have been identified at this stage of design.

Flume Method

The flume method would be suitable for crossing sensitive, relatively narrow water bodies that have straight channels and are relatively free of large rocks and bedrock at the point of crossing. The flume method would not be appropriate for wide or heavily flowing streams. This method involves placement of flume pipes in the water body bed to convey water flow across the construction area, isolating the stream flow from the trench water.

Flumes would be selected with sufficient diameter to transport the maximum flows anticipated at the respective crossings. The flumes, typically 40 to 60 feet long, would be installed before trenching and would be aligned so as not to impound water upstream of the flumes. The flumes would not be removed until after the trench has been dug, the pipeline has been installed, and the trench has been backfilled.

The upstream and downstream ends of the flumes would be incorporated into dams made of sandbags and plastic sheeting (or other suitable material). The upstream dam would be constructed first and would funnel stream flow into the flumes. The downstream dam would prevent backwash of water into the trench and construction work area. The dams would be monitored and adjusted to minimize leakage.

After the flume has been installed and is functioning properly, backhoes located on one or both streambanks (or within the streambed itself if it is too wide) would excavate the trench. Spoil from the stream or riverbed and banks would be placed at least 10 feet from the water's edge or in the extra workspace. The spoil would be contained as necessary by a silt fence to minimize sediment movement.

Standing water that is isolated in the construction area by the dams or any water that leaks through the dams or seeps from the ground into the trench during construction would be pumped to an area in a manner designed to prevent the flow of heavily silt-laden water back into the stream, and applicable permits would be acquired. Sediment control devices would be used as necessary at the outlets of trench pumps.

After the trench has been excavated, the pipe would be installed. There may be some crossings where the pipe section would be short and straight enough for it to be pulled or lowered in under the flume. However, there would be many crossings where the sagbends on the crossing pipe or the length and weight of the pipe would require the flume to be pulled temporarily. In such cases, the flume would be reinstalled as soon as the pipe is in place.

This is a very common method for water body crossing installation; however, the route would not include many rivers with characteristics that favor the use of this method. The Tatlawiksuk River is one possibility. In winter, this method can be used on large rivers that have very low flow. In summer, its use would be limited to small streams.

Channel Diversion

The channel diversion method diverts a stream or river from its natural channel to a temporary channel excavated for that purpose. It can also involve diverting a stream or river flow into another natural stream channel. This can be accomplished by constructing dams both upstream and downstream of the pipeline crossing area in the water body to cause the flow to be diverted through the temporary diversion channel. Excavation and pipe installation can then proceed across the natural channel while being isolated from the flow. After the pipe has been backfilled and the banks have been restored and protected as required, the dams would be removed while the ends of the diversion channel are simultaneously being backfilled to allow the flow to return to the original channel. This method requires suitable flat terrain adjacent to the stream or river. Diverting flow into a newly excavated channel would produce some sedimentation, so the use of a natural channel is preferable.

Horizontal Directional Drilling

HDD is a trenchless crossing method that may be used to avoid direct impacts on sensitive resources, such as water bodies, by directionally drilling beneath them. HDD involves installation of the pipeline beneath the ground surface by pulling the pipeline through a pre-drilled bore hole. HDD installation is typically carried out in three stages: (1) directional drilling of a small-diameter pilot hole; (2) enlarging the pilot hole to a sufficient diameter to accommodate the pipeline; and (3) pulling the prefabricated pipeline, or pull string, into the enlarged bore hole. Figure 2.3-31 depicts a typical HDD crossing schematic. Figure 2.3-32 depicts a typical HDD entry site equipment layout.

Six of the 42 major water body crossings are proposed as HDD crossings:

- Skwentna River (MP 50) 2,981 feet;
- Happy River (MP 86) 3,453 feet;
- Kuskokwim River (MP 240) 7,101 feet;
- East Fork of the George River (MP 283) 4,532 feet;
- George River (MP 290) 2,957 feet; and
- North Fork of the George River (MP 298) 3,281 feet.

According to the Natural Gas Pipeline Plan of Development (SRK 2013b), HDD crossing locations were determined based on the following criteria:

- Is this a significant sized river that presents engineering / other challenges for trenching?
- What is the technical feasibility of drilling, can it be done with current technology?
- Is there significant traffic on the river?
- What is the proposed season for construction and trenching (if not drilled), summer or winter?
- Is this a river that has environmental or engineering considerations that would mandate evaluating the use of HDD?
- What are the environmental, engineering, and schedule impacts associated with HDD at the crossing?

Estimated water use requirements at a rate of 4,050 to 6,000 gpm withdrawal rate and drilling cuttings and mud disposal at HDD crossings are summarized in Table 2.3-32.

HDD operations would be addressed in the HDD Plan which would be prepared to meet regulatory requirements including management and disposal of drill cuttings and drill mud generated as a result of HDD operations. HDD drill cuttings and drilling mud disposal options include disposal in onsite ADEC permitted pits or offsite disposal depending in part on the types of additives that are needed to complete the drilling.

Surface Water Crossing Mitigation

Potential impacts to surface water resources would be mitigated during pipeline construction by following general procedures designed to minimize alterations to stream channel bed and banks that could lead to increased erosion and sedimentation in the channel. The following BMPs would be implemented at surface water crossings as necessary (SRK 2013b):

- Construction precautions would be taken for activities across water bodies to minimize terrain disturbance;

- Maintaining, to the maximum extent practicable, the existing surface hydrology at all water body crossings;
- Trench plugs would be used to prevent sediment-laden water from entering a surface water body;
- Trench spoil would be placed at least 30 feet from the edge of a receiving water body;
- Locating fuel storage, equipment refueling, and equipment maintenance operations at least 100 feet from surface waters;
- Stabilization of the water body shoreline would include installation of erosion control matting to armor the approach where disturbance has occurred;
- Wattles, silt fences, brush berms, or rolled erosion control products would be installed parallel to the shoreline across the entire construction ROW to minimize sediment before it enters the receiving water body (see Section 3.2, Soils, for additional erosion control measures);
- If required, temporary silt curtains would be installed and used as a turbidity barrier along the edge of water bodies. The curtains would be installed during periods of active construction;
- Stream channel banks would be revegetated and graded to their original configuration, or to a more stable configuration if original stream banks were unstable; and
- Silt-laden water produced from trench dewatering would be pumped through filter bags and discharged into an energy dissipater before entering any surface water.

At stream and river crossing approaches, temporary erosion control measures would be removed only when vegetation on the bank has progressed to the point where it can prevent erosion and keep sediment from entering the receiving water body.

Summary – Surface Water Crossings

Potential impacts to surface water from clearing and grading within the construction ROW at stream crossings includes increased runoff, erosion, and sedimentation due to removal of vegetation and soil compaction from equipment. Pipeline construction would not result in long-term alterations to stream flow, stream profile, or structural components of streams and other water bodies crossed by the pipeline (see Section 3.11, Wetlands, for description of wetlands crossing). For most stream crossings, temporary disturbances to water bodies would be limited to the construction phase. Stream beds, banks, and riparian areas would be restored to pre-project contours and configurations to the maximum extent possible. Channel banks and riparian areas would be revegetated to prevent erosion and to maintain bank stability.

Design and implementation of erosion control procedures and BMPs at each water body crossing would minimize potential impacts to surface water flow and sediment load. Additionally, potential impacts to surface water are reduced by installing the pipeline across most water bodies during winter months and low stream flow conditions. Therefore, the magnitude of the impact of pipeline construction on surface water flow and sediment load at pipeline crossings is expected to be low. The magnitude of potential scour effects would be low to medium (design adequate for conditions), and would be minimized through increased depth of cover in high hazard areas and bank stabilization techniques. The duration of the ROW runoff and erosion impacts is expected to be temporary (primarily lasting through the construction period of 3 to 4 years), and the duration of scour impacts could be long-term to permanent. Some stream crossings would require water diversion around the construction area; however, the potential impacts to stream flow are expected to be negligible to minor, and the geographic extent is expected to be local. The context is considered common to important for this abundant but shared and regulated resource.

Wetland Crossings

The method of pipeline construction to be used in wetlands and the required width of the construction ROW would depend on the season, the presence or absence of permafrost, the classification of the wetland, access, and environmental conditions at the time. There would be three basic approaches to crossing wetlands. The most common method would be winter construction, but some summer crossing of wetlands will be required. These may be crossed using a gravel fill workpad or using temporary workpad over geotextile, or other method of separation that would supplement the pad.

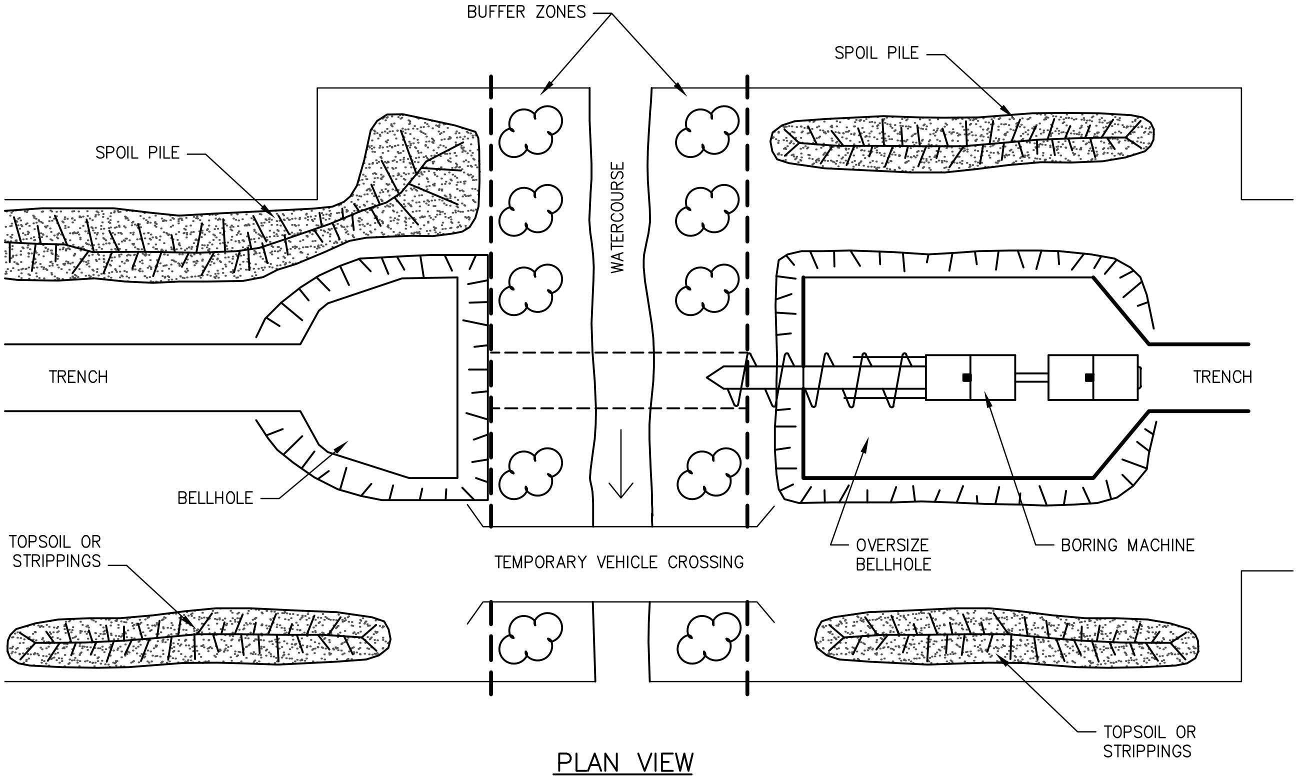
Winter construction is planned for a majority of the route. In winter, wetlands that are underlain by permafrost would be crossed using an ice or snow pad. Wetlands without permafrost would be frost packed to freeze them down to more competent soils or deep enough to support the pipe and construction equipment. There may also be wetlands with a deep active layer that would be frost packed because the active layer does not need an ice pad. In deep wetlands or in mild winters, it may be necessary to place timber corduroy or mats in the wetland, even in winter, to support the pipe and/or equipment. Winter matting would be used for warm or short winters.

For summer construction in wetlands without permafrost, workpads can be temporary. They would be made from imported fill and/or trench spoil (if suitable) or timber mats. A layer of geotextile or mats would be used to separate fill from vegetation. Upon completion, the fill and other materials would be removed.

Vegetation within wetlands would be cut to ground level, and stump removal would be restricted to the trench line, except where necessary to maintain safety. The upper 12 inches (30 cm) of organic material would be segregated from the area to be disturbed by the trench except in winter.

In winter, no sediment barriers would be necessary at wetland boundaries or along the edge of the ROW or spoil piles. In summer, sediment barriers would be installed immediately upslope of wetland boundaries as necessary to prevent sediment flow into the wetland. Where the ROW is located through or adjacent to wetlands, sediment barriers would be installed along the edge of the ROW to contain spoil and sediment within the ROW as needed.

In winter, temporary workspace setbacks would not be necessary and can be limited to 10 feet. Sometimes it would be necessary to have temporary extra workspace for a river crossing located in the adjacent wetland. In summer, extra temporary workspaces would generally be set back at least 50 feet from the edge of delineated wetlands where topographic conditions permit.



PLAN VIEW
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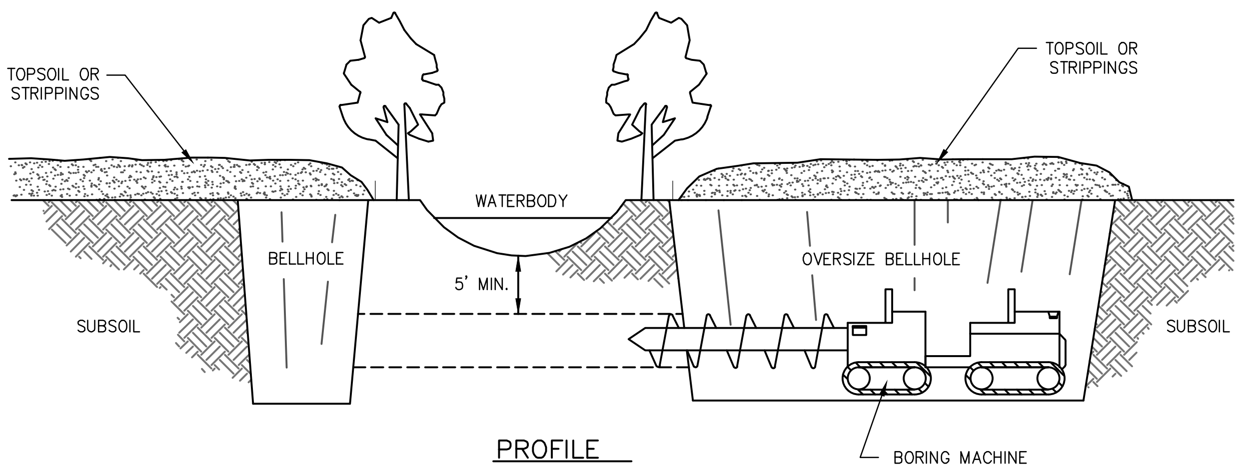

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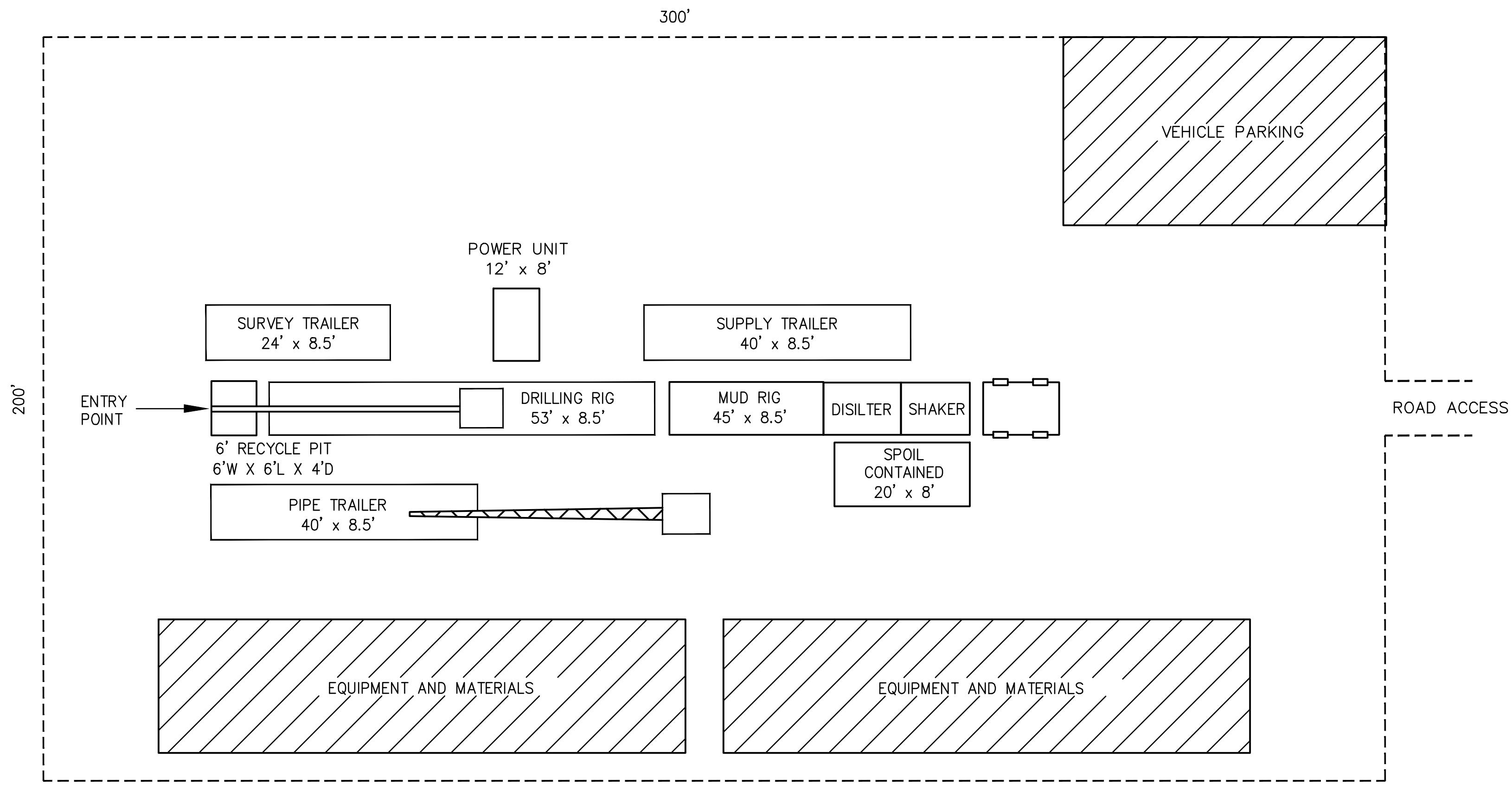
ALTERNATIVE 2
TYPICAL HDD CROSSING

NOVEMBER 2015 FIGURE 2.3-31



NOTE:
THIS IS A TYPICAL SITE SET-UP. THERE ARE VARIOUS CONFIGURATIONS USED DEPENDING UPON SITE RESTRICTIONS. FIELD MODIFICATIONS TO SUIT SITE.

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ALTERNATIVE 2
TYPICAL HDD ENTRY SITE
EQUIPMENT LAYOUT

NOVEMBER 2015

FIGURE 2.3-32

Table 2.3-32: HDD Estimated Water Use

HDD Crossing Name	Length (ft)	Estimated Total Water Requirement (gal)	Estimated Total Volume Solids/Cuttings Needing Disposal (cy)	Estimated Total Volume of Drilling Mud for Disposal (gal)
Skwentna River	2,981	350,000-375,000	250-260	180,000-200,000
Happy River	3,453	450,000-500,000	280-290	240,000-260,000
Kuskokwim River	7,101	900,000-925,000	590-600	440,000-460,000
East Fork George River	4,532	500,000-525,000	375-385	250,000-270,000
George River	2,957	325,000-350,000	245-255	160,000-180,000
North Fork George River	3,281	425,000-450,000	270-280	220,000-240,000

Notes:

Estimated volume ranges rely on assumptions regarding drilling methods and ground conditions to be encountered; therefore, actual volumes can vary considerably and operations would be planned accordingly. Estimates would be refined during final design.

cy = cubic yards ft = feet gal = gallons

Source: SRK 2013b.

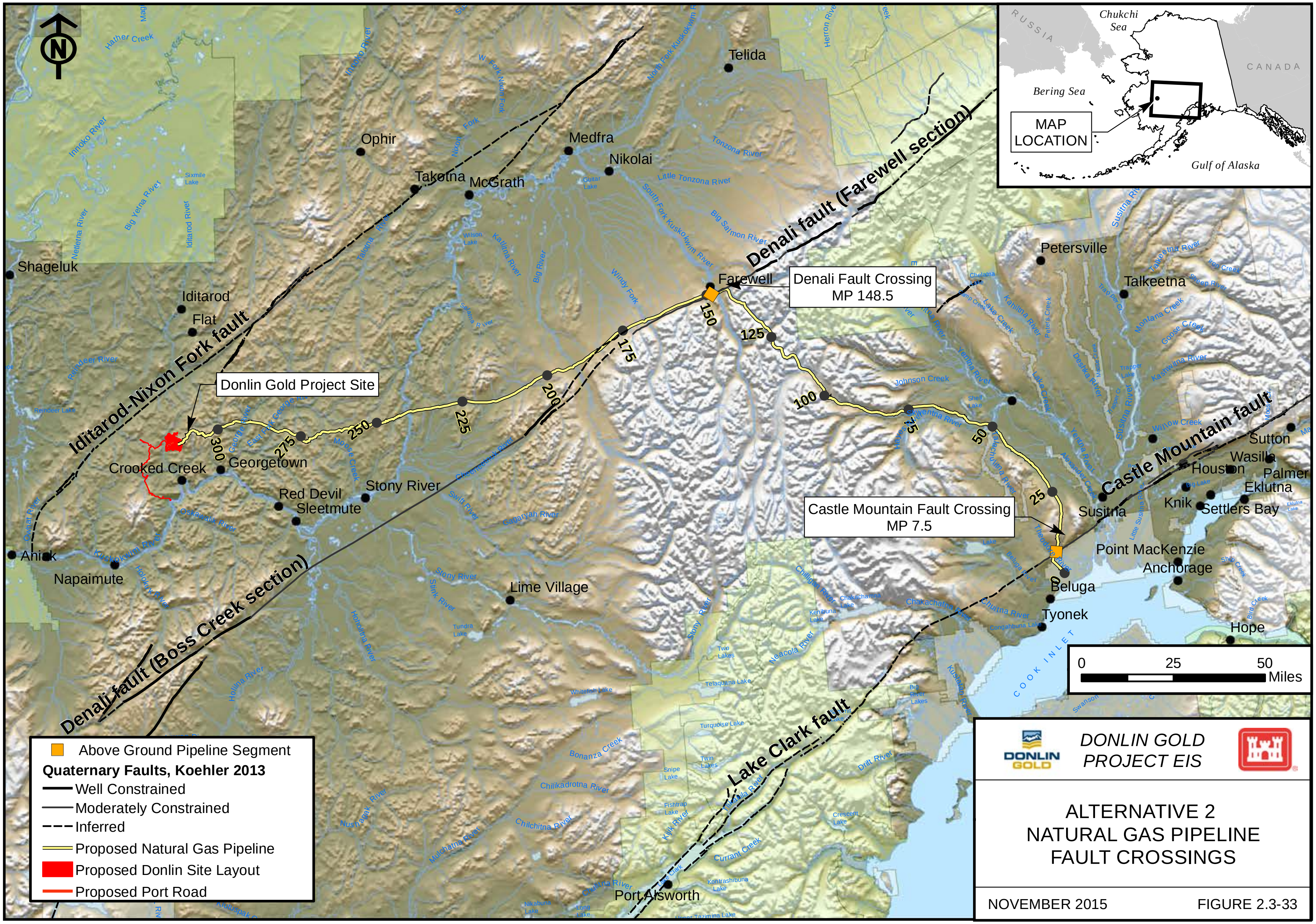
After the pipeline has been lowered into the trench, the trench would be backfilled with excavated trench spoil. A permanent slope breaker and trench breaker would be installed at the boundary to the wetland. Trench breakers would also be used to prevent the pipeline trench from draining a wetland and as necessary to maintain the original wetland hydrology.

Active Fault Crossings

There are two identified active faults that the pipeline route would cross using above ground methods. These are the Denali-Farewell Fault and the Castle Mountain Fault as shown on Figure 2.3-33. The pipeline would cross the western end of the Castle Mountain Fault at approximately MP 7.5, where the slip rate is relatively low and the most recent movement identified during geologic studies was Pleistocene or older.

The Denali-Farewell Fault intersects the pipeline route near MP 148.5, west of the South Fork of the Kuskokwim River on the northern edge of the Alaska Range. The pipeline route crosses the western end of the central Denali Fault near Farewell, where the slip rate is lower. During any future seismic event on these faults, permanent ground displacement from fault movement is expected to be primarily horizontal rather than vertical. The most recent surface rupture of the Denali-Farewell fault system is considered to be mid-Quaternary.

A preliminary fault-crossing stress analysis conducted for both crossings produced a recommendation for an above-grade design with the pipeline in a "Z" configuration at each end of the potential movement zone to ensure flexibility. Final designs for the above-ground crossings at the Denali-Farewell and Castle Mountain Faults would allow the pipe to move freely above ground on grade beams and/or vertical support beams during seismic shifting without overstressing the pipe. The fault crossing design is based on the Trans-Alaska Pipeline System design for crossing the Denali Fault.



MAP LOCATION
Chukchi Sea
RUSSIA
CANADA
Bering Sea
Gulf of Alaska
Denali fault (Farewell section)
Denali fault (Boss Creek section)
Iditarod-Nixon Fork fault
Castle Mountain fault
Lake Clark fault
Donlin Gold Project Site
Denali Fault Crossing
MP 148.5
Castle Mountain Fault Crossing
MP 7.5
Telida
Ophir
Medfra
Nikolai
Takotna
McGrath
Shageluk
Iditarod
Flat
Farewell
Petersville
Talkeetna
Crooked Creek
Georgetown
Red Devil
Sleetmute
Stony River
Aniak
Napaimute
Lime Village
Sutton
Wasilla
Houston
Palmer
Eklutna
Knik
Settlers Bay
Susitna
Point MacKenzie
Anchorage
Beluga
Tyonek
Hope
Port Alsworth
COOK INLET
0
25
50
Miles
Above Ground Pipeline Segment
Quaternary Faults, Koehler 2013
Well Constrained
Moderately Constrained
Inferred
Proposed Natural Gas Pipeline
Proposed Donlin Site Layout
Proposed Port Road
DONLIN GOLD
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ALTERNATIVE 2
NATURAL GAS PIPELINE
FAULT CROSSINGS
NOVEMBER 2015
FIGURE 2.3-33

At both of the above-ground fault crossings the thickness of the pipe wall would be increased, and a steel plate shroud would cover 75 percent of the pipe. This shroud would protect the pipe from accidental bullet strikes and would still allow the pipe to move on the horizontal supports to alleviate stress from seismic events at these locations.

Pipeline Construction – Blasting

Some material sites, such as Kuskokwim West, where bedrock sources would be used for granular rock fill for road and pad construction, would potentially require blasting. The need for blasting during project construction would be determined during final design. A Blasting Plan would be developed prior to construction for agency review, and would apply in all situations where blasting occurs. All blasting would conform to the rules and regulations of Occupational Safety & Health Administration (OSHA) and of all other relevant federal, state, and local agencies. Federal regulations that apply include, but are not limited to:

- 27 CFR Part 181 – Commerce in Explosives;
- 49 CFR Part 177 – Carriage by Public Highway;
- 29 CFR 1926.900 et seq., Subpart U – Safety and Health Regulations for Constructions – Blasting and Use of Explosives; and
- 29 CFR 1910.109 – Explosives and Blasting Agents OSHA.

Specifications for both ROW grade and trench blasting would be included in the construction documents and would require that detailed blasting procedures be developed before conducting any blasting. Areas of frozen soil and/or bedrock that might be encountered along the proposed pipeline route may also require blasting. Safety controlled blasting techniques would be used in accordance with a Blasting Plan, and would follow all applicable requirements for health, safety, and environmental protection, including standard permit conditions for blasting near fish-bearing water bodies.

Pipeline Construction – Soils, Permafrost and Slope Stability

In areas where the uppermost organic soil can be separated from mineral soils during trench excavation, this material would be recovered and used as the surface portion of the backfill in the trench. Where this material is either nonexistent or not recoverable, an attempt would be made to place finer-grained soils at the top of the trench backfill, in order to facilitate revegetation. In all cases, the trench would be mounded to account for future settlement of trench backfill and to prevent water from ponding over the trench line.

The pipeline route includes more than 100 miles of discontinuous permafrost terrain from approximately MP 100 to MP 205, as shown on Figure 2.3-34. A narrower working surface would be used in areas with steep side slopes. Gravel or granular rock work pads or snow and ice pads would be used in areas of thaw-unstable permafrost or over soft soils that would be unable to support construction equipment, and in areas where removal of the organic layer could allow the permafrost to thaw. This would also apply to wetlands overlaying thaw-unstable permafrost. Narrow working surfaces would be used to minimize cuts in thaw-unstable permafrost and to minimize imported fill for winter work pad on side slopes where ice pads cannot be constructed. Work pads would be left in place after construction, leaving the organic layer intact beneath.

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NATURAL GAS PIPELINE ALIGNMENT PERMAFROST DISTRIBUTION

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FIGURE 2.3-34

Frost packing would be done in winter in locations where soils must be frozen to support construction equipment. Frost packing is usually done on muskeg, wetlands, or other weak soils to accelerate frost penetration. The depth of freezing that would be required would depend on surface and subsurface soil types. Frost packing to depths of 3 to 5 feet is accomplished by packing down the snow to drive the frost deeper into the soil.

Pipeline – Drainage and Erosion Control

Drainage and erosion control measures, both temporary and permanent, would be implemented along the pipeline ROW and at facilities such as camps, storage yards, material sites, and airstrips and roads. Permanent facilities would also require such measures and would include the metering station, compressor station, fiber optic repeater station, pigging station, and MLV locations.

During pipeline installation, a cleanup crew would follow behind the backfill crew and perform all cleanup, rehabilitation, and reclamation of cuts as well as planned erosion control, during the same season as pipe installation whenever possible. A reclamation crew would go back over the ROW during the summer after a winter season to fix any erosion control problems that have developed during breakup, rehabilitate the trench line and working side as needed to facilitate natural revegetation, and then fix any permafrost degradation that may not occur until later in summer. In a summer section, the reclamation crew would follow the cleanup crew during the same summer. This double coverage of erosion control and reclamation efforts in permafrost terrain would provide additional protection of these sensitive areas.

Stabilization of the backfilled trench may be a multi-year process in some areas, particularly areas with fine-grained, ice-rich soils and wetlands. The proposed pipeline trench may intercept overland flow if not properly addressed and change flow patterns that could erode backfill material from the pipeline trench and could potentially serve to channel water into nearby water bodies and wetlands. Some areas may be covered with geofabric or other material to prevent erosion. In disturbed areas where the vegetated mat is not available, the surface would be prepared for natural revegetation or seeded with native species at the earliest opportunity to minimize erosion and siltation. In wetland areas where the native vegetated mat is side-cast during ditch excavation, a temporary platform/holding structure may need to be constructed/employed and used as a holding containment device to allow the material to be recovered and put back into place on top of the trench (the preferred method of natural revegetation).

Slash, chips, stumps, or other wooden materials, including unused tree trunks generated during the clearing process, would be scattered on the ROW to enhance revegetation and create habitat. Tree trunks used to develop corduroy road beds during construction would be left in place on the workpad surface.

During winter construction, temporary erosion control measures would not be necessary. At the latitudes at which the pipeline is to be laid in winter, the weather would be below freezing from the start of winter until spring breakup. Even when ambient temperatures climb above freezing, or when the sun shines brightly in spring, the ground would remain frozen.

For summer construction, temporary erosion control measures such as sediment barriers (for example, brush berms) and temporary slope breakers would be installed as needed to contain disturbed soils on the construction ROW and to minimize the potential for soil to enter wetlands or water bodies. After installation, temporary erosion control measures would be regularly inspected and maintained throughout the duration of construction, until permanent erosion control measures have been installed and reclamation is complete.

Trench plugs would be used in the trench in hilly terrain to prevent water from eroding the trench bottom. Trench plugs would also be used on each side of water body crossings to prevent trench water from entering a stream, river, or wetland.

In addition to reclamation of the ROW, material sites, PSYs, barge landing areas, airstrips, campsites, and temporary access roads would be recontoured and reclaimed to an acceptable condition as required by applicable permits and the approved Stabilization, Rehabilitation, and Reclamation Plan. Revegetation of these disturbed areas would proceed in the same manner as in the ROW.

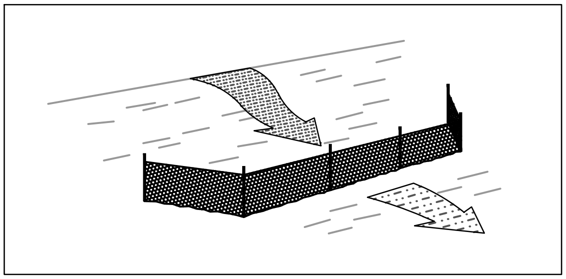
Donlin Gold would develop an Erosion Sediment Control Plan and a SWPPP prior to the commencement of construction. These plans would outline erosion control BMPs which can include the use of silt fences; bale checks; swales; roots; trench and ditch reinforcement with geotextile fabric or rock; and gabions and sediment traps. Figure 2.3-35 provides an example of a typical silt fence sediment barrier. Where present, topsoil would be segregated from subsoil along the pipeline route.

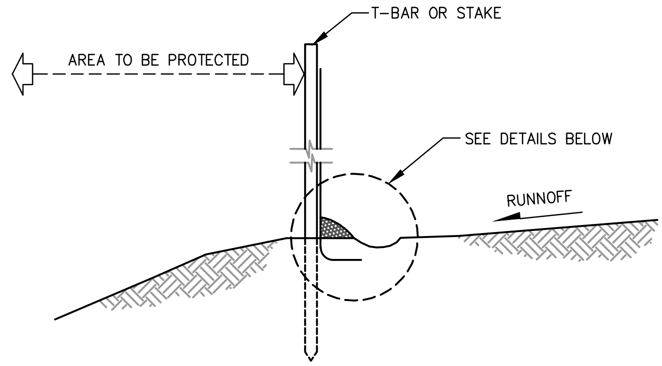
To contain disturbed soils in upland areas and minimize the potential for sediment loss to wetlands and water bodies, temporary erosion controls would be installed in accordance with Donlin Gold's Erosion and Sediment Control Plan and SWPPP prior to initial disturbance of soils, and would be maintained throughout construction. These could include erosion control matting on stream banks (Figure 2.3-36), and temporary soil containment berms (Figure 2.3-37).

Pipeline – Corrosion Protection and Detection Systems

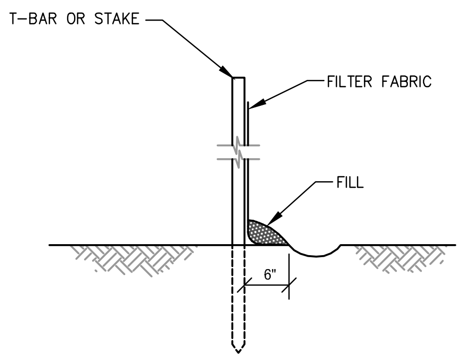
In addition to the coating described above under Standard Lowering-In and Backfilling, the proposed pipeline would use a zinc ribbon for cathodic corrosion protection of the steel pipe. The zinc sacrificial anodes are sometimes referred to as a galvanic system because the anodes used are higher (more active) in the galvanic series than the steel they are protecting. A ribbon of zinc is placed in the pipeline trench and connected to the pipeline through a test station via an insulated wire. Zinc ribbon would be installed after pipe lowering-in and before backfill.

Cathodic protection stations for continuity checks would be installed at approximate 1-mile intervals. Cathodic protection system test sites are often located adjacent to pipeline markers. Land impacts for the cathodic protection system test stations have been accounted for within the temporary construction easement, operations ROW, and permanent workspace requirements for the proposed facilities.

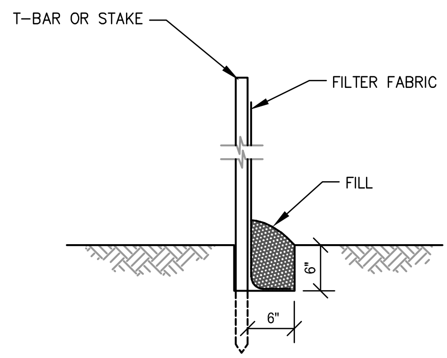




SIDE VIEW
OF SILT FENCE



WITHOUT TRENCH
ROCKY AREAS ONLY



WITH TRENCH

NOTES:

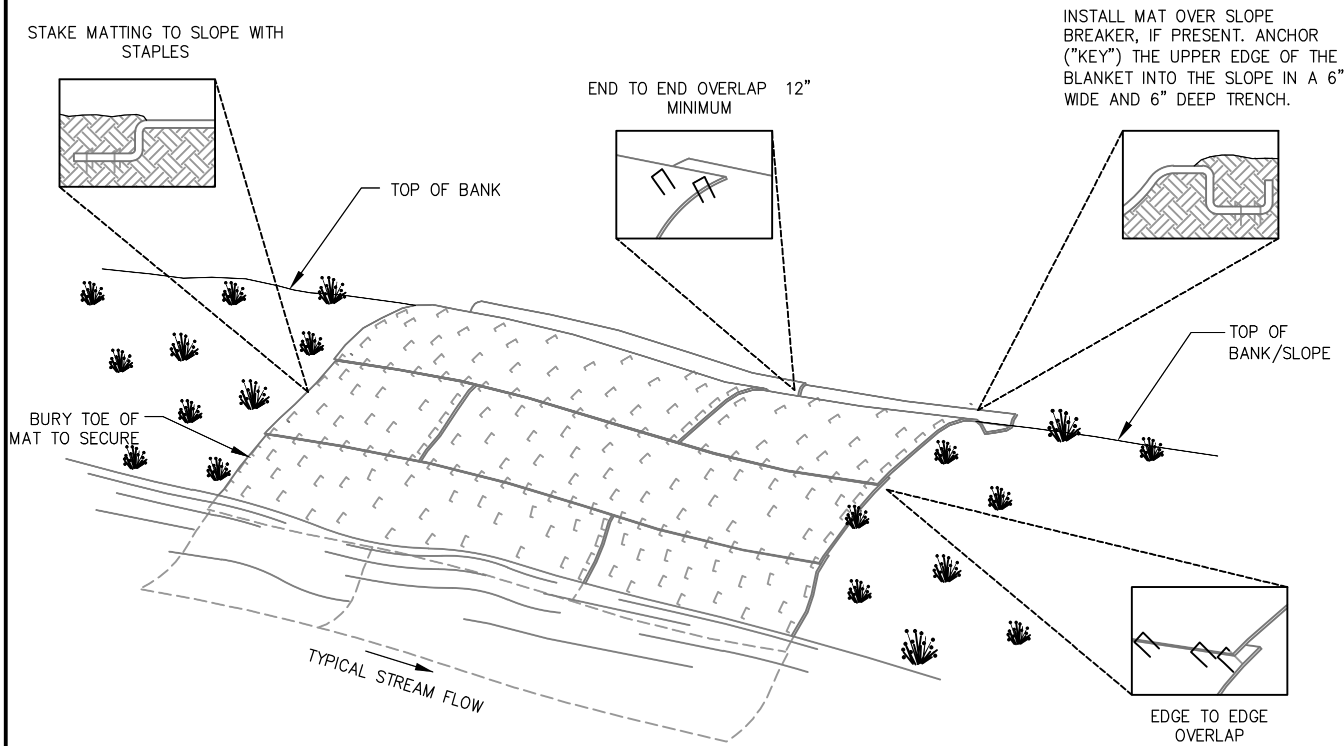
1. SILT FENCE COULD BE UTILIZED AT:
   * THE BASE OF ALL SLOPES ABOVE WETLANDS AND WATERBODIES
   * THE DOWNSLOPE RIGHT–OF–WAY EDGE WHERE ANY OF THE ABOVE–MENTIONED LOCATIONS ARE ADJACENT TO THE RIGHT–OF–WAY.
   * BETWEEN TOPSOIL/SPOIL STOCKPILES AND WATERBODIES OR WETLANDS AS NEEDED.
   * ALONG R.O.W. BOUNDARIES IN WETLAND CONSTRUCTION, AS NEEDED.
   * AS DIRECTED BY THE COMPANY'S REPRESENTATIVE.
2. THE SILT FENCE SHALL BE CONSTRUCTED AS FOLLOWS:
   * FABRIC USED FOR THE SILT FENCE SHALL BE A "STANDARD STRENGTH" GEOTEXTILE.
   * THE HEIGHT OF THE FENCE SHALL BE DONE AT POSTS AND OVERLAP WITH BOTH ENDS SECURED TO THE POST.
3. THE SILT FENCE SHALL BE INSTALLED AS SPECIFIED BY THE MANUFACTURER OR AS FOLLOWS:
   * A TRENCH, 6" WIDE AND 6" DEEP, SHALL BE EXCAVATED ALONG THE CONTOUR. THE POST SHALL BE DRIVEN INTO THE BOTTOM OF THE TRENCH ON THE DOWNSTREAM SIDE OF THE FILTER FABRIC. THE TRENCH SHALL BE BACK FILLED AND COMPACTED, ENSURING 6" OF FENCE IS BURIED WITHIN THE TRENCH.
   * IN AREAS WHERE THE TERRAIN IS TOO ROCKY FOR TRENCHING, A 6" GROUND FLAP WITH ROCK FILL TO HOLD IT IN PLACE SHALL BE USED.

DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
TYPICAL SILT FENCE
SEDIMENT BARRIER

NOVEMBER 2015

FIGURE 2.3-35



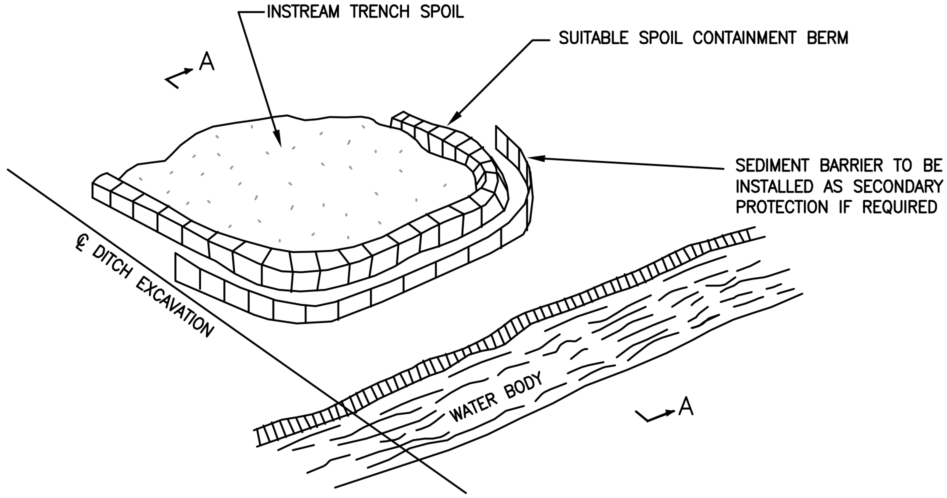
NOTE:

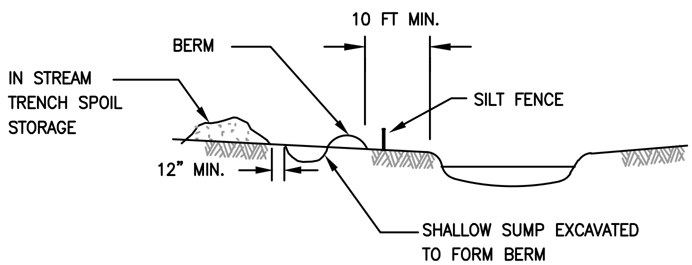
1. EROSION CONTROL MATTING (BLANKETS) COULD BE USED AT THE BANKS OF ALL WATERBODIES AND ON STEEP SLOPES.
2. THE EROSION CONTROL MATTING SHALL MAKE UNIFORM CONTACT WITH THE SOIL UNDERNEATH WITH NO BRIDGING OF RILLS OR GULLY. JOINING MATS SHOULD OVERLAP.
3. MONITOR FOR WASHOUTS, STAPLE INTEGRITY OR MAT MOVEMENT PRIOR TO COMPLETION OF CONSTRUCTION. REPLACE OR REPAIR AS NECESSARY.

DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
EROSION CONTROL MATTING
STREAM BANKS

NOVEMBER 2015 — FIGURE 2.3-36





SECTION A–A

NOTES:

1. SOIL CONTAINMENT BERMS ARE TO BE USED WHERE INSTREAM TRENCH SPOIL COULD REENTER THE WATERBODY DIRECTLY OR INDIRECTLY AND WITH SIMULTANEOUS UTILIZATION OF SEDIMENT BARRIERS IF REQUIRED.
2. MATERIAL USED FOR THE CONTAINMENT BERM SHOULD BE KEPT TO A HEIGHT WHICH REMAINS STABLE DURING THE CONSTRUCTION PERIOD.
3. CARE SHOULD BE TAKEN THAT THE SPOIL PILE DOES NOT OVERTOP THE CONTAINMENT BERM.
4. THE CONTAINMENT BERM SHOULD BE DISMANTLED AND THE SITE RESTORED TO THE ORIGINAL CONDITION UPON COMPLETION OF THE WATER CROSSING.
5. CARE AND ATTENTION MUST BE TAKEN TO ENSURE SPOIL CONTAINMENT BERMS ARE MAINTAINED.
6. FULL CONSIDERATION FOR OVERALL SLOPE STABILITY IS REQUIRED WHEN SELECTING A SPOIL CONTAINMENT LOCATION.

DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
TEMPORARY SOIL CONTAINMENT BERM

NOVEMBER 2015

FIGURE 2.3-37

The pipeline would be surveyed at least once each calendar year, but at intervals not exceeding 15 months, to determine whether cathodic protection levels are adequate. The degree of cathodic protection would be controlled to prevent damage to the protective coating of the pipe:

- All pipeline test site corrosion survey data would be analyzed to verify that potentials meet minimum standards of compliance.
- Atmospheric corrosion surveys would be conducted on each pipeline and facility every 3 years.
- Non-critical interference bonds would be checked at least once each calendar year, at intervals not exceeding 15 months.
- When low pipe-to-soil potentials are found during cathodic protection surveys, remedial measures would be implemented.

The cathodic protection system would be operational as soon as possible after commissioning and startup of the proposed pipeline. The design, installation, and implementation would meet all regulatory requirements to assess the adequacy of the cathodic protection system.

<u>Pipeline – Pressure Testing</u>

The entire pipeline would be pressure tested before it is put into service to verify its integrity and its ability to withstand maximum operating pressures. The test would be conducted in compliance with USDOT regulations (49 CFR Part 192). Before the pressure test, each section of pipe would be cleaned. A detailed Pressure Test Plan would be developed during final design to address all aspects of pressure testing.

The pipeline would be pressure tested using water (hydrostatic testing or hydrotesting). Incremental segments of pipe would be filled with water, pressurized, and held for the required duration of the test. The length of each segment tested would depend on topography. Hydrotesting would be conducted in summer, since winter hydrotesting is difficult because of freezing of water in pipe.

As a result, all pressure testing would most likely be done in the summer to avoid the need for antifreeze. To conduct hydrotesting, tests of individual segments typically would be conducted in a sequence in which the test water would be transferred from one segment to another. Test water would be obtained from approved sources in accordance with permit requirements; screens on the intake hoses at surface water sources would be used to prevent entrainment of fish or other aquatic species and to monitor the withdrawal rate to maintain adequate downstream flow to support aquatic life. Volumes of water required would vary depending on hydrotest segment length but could be up to 15 Mgal. An APDES permit would be acquired for the discharge of hydrostatic testing water.

Once hydrostatic testing has been completed, test water would be discharged back to an approved location through a filtration device. Discharge of the hydrotesting water may require a wastewater discharge permit if any foreign substances are added to the water. Water used for pipeline test purposes would be tested before discharge, as required by project permits. Energy-dissipating devices and/or filter bags would be used to prevent scour, erosion, suspension of sediment, and damage to vegetation. Discharge rates would be monitored and kept within a range appropriate to maintain the effectiveness of the energy-dissipating devices.

Pipeline – Commissioning

After pressure testing, any necessary tie-ins would be made. The welds on the tie-ins would be inspected and the pipeline dried (if required) before commissioning begins. Commissioning would include testing of controls and communication systems before pipeline operation.

Pipeline – Construction Work Force and Schedule

The pipeline construction workforce size is expected to peak during the two winter construction seasons, at approximately 650 people. Refer to Table 2.3-30 for timing related to mobilizing and demobilizing these camps. For summer seasons, the effort would be similar. During the first summer, workers would mobilize to the mine site.

2.3.2.3.6 PIPELINE – DECOMMISSIONING, ABANDONMENT, AND RECLAMATION

Donlin Gold plans to decommission and abandon the natural gas pipeline at the conclusion of the operations and maintenance phase. Donlin Gold would develop and follow a detailed Pipeline Abandonment Plan based on regulatory requirements at the end of decommissioning. However, the State of Alaska has not determined the future of the pipeline on state lands past the mine life. The pipeline would have common carrier status and therefore may not be decommissioned after mine life. As a condition of the pipeline ROW lease, the State may choose to maintain the pipeline for another purpose (statutory authority AS 38.35.030).

In general, pipes would be purged and cleaned. All above-ground facilities would be removed, including compressor stations, piping, equipment, buildings, fencing, above-ground river crossing structures, access road culverts, and tanks. Above-ground pipelines would be removed to 1 foot below grade and underground pipelines would be capped and abandoned in place. Unless required by regulations in place at the time of abandonment, monitoring of the abandoned in-place pipeline would not be conducted. Some below-ground facilities, such as valves, may be excavated at certain locations. Gravel pads would be left in place and scarified and prepared for natural revegetation. Materials that could be salvaged or recycled would be transported to in-state and out-of-state facilities. Hazardous, solid, and liquid wastes would be properly disposed. After removal of facilities, cleared land would be contoured to restore appropriate grades, and revegetated.

Above-Ground Facilities

Donlin Gold would develop a Stabilization, Rehabilitation, and Reclamation Plan that also would include final reclamation actions at termination and costs / surety estimates applicable to project final reclamation. The Abandonment Plan and procedures would be based on applicable regulatory requirements at the time, and would be designed to minimize impacts to public and private property in coordination with the appropriate agencies and land owners, unless required otherwise as listed below. Steps for decommissioning follow:

- All above-grade pipeline structural facilities would be removed. Gravel pads would remain in place and be scarified and prepared for natural revegetation.
- All pile foundations would be excavated to a minimum of 12 inches below grade, cut off, capped, and backfilled to grade.

- All aerial markers would be removed; aerial marker foundation posts would be excavated to a minimum of 12 inches, cut off, and backfilled to grade.
- All Carsonite-style pipeline markers would be removed.
- Terminus facilities at the mine would be removed as part of mine demolition.
- Inlet metering facilities at the tie-in would be removed concurrently with removal of the compressor station. The metering modules would be removed from their foundations and transported to Anchorage by truck and barge, where they would be dismantled, salvaged, recycled, or disposed of as appropriate.
- The compressor station site would be dismantled to transportable units, and then trucked and barged to Anchorage where they would be further dismantled for salvage, recycle, or disposal as appropriate.
- Any other signs or markers would be removed.
- All fencing around facilities would be removed and transported back to Anchorage for salvage or recycle.
- Purging of any remaining natural gas by pigging the line with a cleaning pig and nitrogen, after followed by air.
- Capping and burying all open ends of the pipeline including the tie-in point, terminus, above-ground pipe sections, and pigging facilities.
- Cutting the above-ground sections of the pipeline at fault crossings into manageable lengths and hauling them away for recycling. This would include the horizontal steel support beams at these locations.
- Cutting off the support piles for horizontal beams at fault crossings 12 inches below grade, then capping them and covering with soil.
- Removing all above-grade ancillary piping at the MLV locations, including valves, fittings, and appurtenances.
- Abandoning in place all below-grade pipe, including pipe at HDD locations.
- Excavating pipe that transitions from above grade to below grade to a minimum of 12 inches below grade, then cutting the pipe off, capping with 0.25-inch steel plant, seal welding, and backfilling to grade. Below-grade valves would remain in place, but valve operator extensions would be excavated and removed.
- Abandoning in place the valve vault at the tie-in to the BPL; removing the pipe at the hot tap valve, and blinding the valve.

The Castle Mountain Fault above-ground fault pipeline crossing would be removed prior to, or concurrently with, removal of the compressor station, and materials from the fault crossing would be staged at or near the compressor station or Beluga for removal with compressor station materials. The Denali-Farewell Fault above-ground fault crossing would be removed as would be the Farewell launcher / receiver, and materials from the crossing would be staged at the existing Farewell strip for removal with launcher / receiver site materials.

Transmission Line and Fiber Optic Cable

The power supply transmission line would be removed from the pole supports and transported back to Anchorage for recycle or disposal. The foundation system (poles) supporting the electric transmission line to the metering station and the compressor station would be excavated to a minimum of 12 inches below grade, cut off, and backfilled to grade if wooden poles are placed directly in the ground; if the poles are supported on H piles, the piles would be excavated to a minimum of 12 inches below grade, cut off, and backfilled to grade.

All buried fiber optic cable would be abandoned in place at the termination of the project as specified in the Stabilization, Rehabilitation, and Reclamation Plan including any cable installed with the pipe using HDD. Fiber optic cable would be excavated to a minimum of 12 inches below grade, cut off, and appropriately located and preserved in a manner that would allow future use. Any above grade cable would be removed at the same time as removal of the above grade pipe, and salvaged or disposed of at an appropriate facility.

Fiber optic cable would be removed from the power supply transmission line pole supports and transported back to Anchorage for recycle or disposal if the poles are used to carry the fiber optic cable. The repeater station would also be removed. If, at termination of the pipeline, a determination is made that the fiber optic cable would remain for future use, the above-ground portions of the cable would need to be addressed, specifically if the transmission line support structures are used to carry the cable to the metering station, at the fault crossings, and where the cable is associated with facilities such as the metering station and the compressor station as these would be removed at termination. In such a case, the repeater station would remain and may require modification.

Roads, Airstrips and Material Sites

No new roads would be retained for operation and maintenance purposes following construction. All temporary access roads and shoofly roads would be stabilized, recontoured, reclaimed, and revegetated as required following established procedures and the approved Stabilization, Rehabilitation, and Reclamation Plan. Temporary bridges and culverts would be removed. This would include, for example, the access roads from the two Kuskokwim River barge landings to the Kuskokwim East and Kuskokwim West camps and airstrips.

Under Alternative 2, none of the nine new airstrips constructed for pipeline construction purposes would be retained. Following the construction period, these new temporary airstrips would be “decommissioned in a way to prevent future use,” according to the Donlin Gold Natural Gas Pipeline Plan of Development (SRK 2013b). Facilities and equipment would be removed, the sites stabilized, rehabilitated, and reclaimed, including redistribution of the vegetative mat where it was stripped and stockpiled during construction. Any of the temporary airstrips that may be reopened during the operations period for maintenance purposes of the pipeline would be reclaimed as required following established procedures and the approved Stabilization, Rehabilitation, and Reclamation Plan and the authorization allowing for such use. This would include any temporary roads for access to the airstrip.

Retention of material sites beyond construction is not expected under Alternative 2. However, any new material sites or any reopened during operation of the pipeline or that may be retained for operations and maintenance purposes following construction would be stabilized, rehabilitated, and reclaimed as required following established procedures and the approved site reclamation plan for the specific material site that would be individually authorized by a material sale.

Any material stockpiles remaining either at a material site or elsewhere would be reconfigured by contouring to the surrounding area, scarified, and prepared to allow for natural revegetation.

Disposition of Salvageable Materials

Donlin Gold does not anticipate transferring any excess materials, equipment, fuel, or other goods to any homesite, homestead, lodge owner or others along the proposed pipeline.

- All salvaged materials from the west side of the Alaska Range would be transported to the Donlin Gold mine site for disposal as part of the mine salvage materials.
- All salvage materials from the east side of the Alaska Range would be transported to Anchorage for salvage, recycle, or disposal.
- A storage yard may be required in Anchorage to manage the salvage, recycle, or disposal of materials brought back to Anchorage.

Final Stabilization, Rehabilitation and Reclamation of Disturbed Areas

All final demolition, removal, and reclamation of the proposed Donlin Gold pipeline and structures, electric transmission line, and fiber optics cable and adjunct areas would be subject to the approved Stabilization, Rehabilitation, and Reclamation Plan, applicable requirements of the Federal Pipeline ROW Grant, the State Pipeline ROW Lease, and any other applicable landowner authorizations or agreements for the project.

2.3.2.3.7 MONITORING ACTIVITIES

The objective of monitoring is to provide long-term assessment of resources, particularly for water resources that could be affected by the mine, and to document that compliance goals are being achieved. Monitoring activities are considered part of Donlin Gold's Proposed Action (SRK 2012d, 2013b). Monitoring activities proposed during construction, operations, and post-closure are based on the current Plan of Operations; however, final monitoring requirements would be established in final permits and approvals required for the project.

Construction, and Operations and Maintenance

Surface Water and Groundwater

The surface water and groundwater monitoring program initiated prior to construction would be refined and continued during construction and operations. Several established surface water monitoring stations on Crooked and Anaconda creeks downstream of the mine would continue to be sampled on a quarterly basis. Additional monitoring of surface water and groundwater would be conducted at new mine facilities such as the WRF and lower CWD, Snow Gulch Reservoir, and wells downstream of the TSF quarterly and/or daily or weekly (see Table 2.3-33).

The type and frequency of monitoring would vary for: contact water, non-contact water, dewatering water, process water, and effluent. Constituents to be analyzed vary with each of these categories, but may include metals, cyanide, and general water quality parameters such as pH, total dissolved solids, anions, cations, and nutrients. The frequency of monitoring would vary from daily for specific parameters at the process plant, to quarterly for most surface and groundwater monitoring locations. The monitoring frequency for treated water from the pit dewatering wells would vary depending on APDES permit requirements for discharge to Crooked Creek. Monitoring parameters and frequency would be updated based on regulatory or permit changes, process modifications, and monitoring results. All sampling and analytical work would be conducted in accordance with an ADEC-approved Quality Assurance Project Plan.

Routine sampling and analysis of domestic wastewater and potable groundwater would be in accordance with Alaska and EPA regulations. Potable water supplies would also be monitored to detect free chlorine and chlorine byproducts. The use of disinfectants such as chlorine can react with naturally occurring materials in the water to form unintended organic and inorganic byproducts which may pose health risks. ADEC requirements for monitoring frequency range from monthly to annually depending upon the substance monitored and monitoring results.

Other Monitoring Programs

Waste characterization monitoring would be performed on rock removed from the pit to determine its ultimate destination (for example, ore stockpiles/process plant, PAG 7 temporary storage, PAG 6 cells, or WRF). Acid-base accounting would be used as a primary diagnostic tool for determining waste management category and destination. Details of waste characterization and monitoring would be finalized in the Integrated Waste Management Plan and the Monitoring Plan.

Monitoring during construction and operations would also include visual inspections of the TSF, WRF, dams, and solid waste landfill for erosion, mass stability, seepage areas, debris, and stormwater control structures. Instrumental monitoring of mass stability would also occur. Visual inspections of the mine access road and Angyaruaq (Jungjuk) Port, airstrip, and material sites would be conducted for stormwater and erosion control purposes in accordance with Stormwater Pollution Prevention Plan (SWPPP) requirements.

Visual inspections of the tailings impoundment pool and depositional areas will be made during each operations shift to observe any unusual circumstances involving birds or other wildlife. If possible, birds or other wildlife mired in unconsolidated tailings would be extracted or herded to a safe area, and all mortalities would be collected and reported to U.S. Fish & Wildlife Service (FWS) and Alaska Department of Fish & Game (ADF&G) within 24 hours.

Other monitoring activities include cultural resources monitoring. A Non-Native Invasive Species Prevention Plan would be developed and implemented during construction, operations and maintenance, and termination phases of the project and would include annual monitoring and treatment plans to mitigate impacts.

Table 2.3-33: Construction; Operations and Maintenance' and Post-Closure Monitoring Summary

Phase	Component	Media	Parameters	Frequency	Project Plan/Permit
Construction	Project Area streams (sample sites at Anaconda Creek Crooked Creek below Omega Creek, Crooked Creek below Crevice Creek)	Surface water	Water quality, flow	Quarterly	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume III A)
	Pit dewatering, (Water Treatment Plant -1 prior to discharge into Crooked Creek)	Groundwater	Water quality, flow	Per APDES permit	APDES Permit / Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume III A)
	WRF	Waste rock (sampling occurs in development of ACMA and Lewis pits)	Acid-Base Accounting	Annual	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume III A) / Integrated Waste Management Waste Rock Management Plan (Donlin Gold Project Plan of Operations Volume III B)
	Lower CWD	Surface water (contact water collected in contact water dam)	Water quality	Quarterly	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume III A)
	Stripped areas (ACMA and Lewis pits WRF, TSF)	Overburden	Acid-Base Accounting	Annual	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume III A) / Integrated Waste Management Waste Rock Management Plan (Donlin Gold Project Plan of Operations Volume III B)

Table 2.3-33: Construction; Operations and Maintenance' and Post-Closure Monitoring Summary

Phase	Component	Media	Parameters	Frequency	Project Plan/Permit
Construction (cont'd)	TSF starter dam	Surface water	Water quality	Quarterly	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume III A)
	TSF (seepage recovery system), groundwater interceptor wells)	Groundwater	Water quality	Quarterly	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume III A)
	TSF compliance monitoring wells	Groundwater	Water quality	Quarterly	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume III A)
	Sanitary facilities Construction camp (Wastewater Treatment Plant -2, Wastewater Treatment Plant -3 prior to discharge into Crooked Creek)	Surface water	Water quality, flow	Per APDES permit	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume III A) / APDES permit
	Potable water	Drinking water	Free chlorine, total coliform bacteria, combined total triha-lomethanes, haloacetic acids, cross-connections	Varies	ADEC permit requirements / Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume III A)
	Solid waste landfill (Mine Site and Angyaruaq (Jungjuk) Port)	Debris, contents	Visuals	Varies	Integrated Waste Management Plan
	Mine Access Road, airstrip, borrow pits, etc. (disturbed areas ≥ one acre)	Storm water	BMP Performance/water quality per SWPPP	Per SWPPP	Construction General Permit (stormwater) / SWPPP

Table 2.3-33: Construction; Operations and Maintenance' and Post-Closure Monitoring Summary

Phase	Component	Media	Parameters	Frequency	Project Plan/Permit
Construction (cont'd)	Natural Gas Pipeline	Construction activities (general)	Compliance with Pipeline Integrity Management System, QA/QC Plan	Ongoing	Natural Gas Pipeline Plan of Development (POD)
	Natural Gas Pipeline	Construction activities (wetlands and water crossings)	Compliance with Pipeline Surveillance and Monitoring Plan	Ongoing	Plan of Development
	Natural Gas Pipeline	Avalanches	Stability/safety	As necessary	Plan of Development
	Natural Gas Pipeline	Reclamation (vegetation)	Success	Post-reclamation (construction)	Stabilization and Rehabilitation Plan, Pipeline Surveillance and Monitoring Plan
	Natural Gas Pipeline	Surface Water	Stream Crossings	As necessary during construction	Plan of Development / Pipeline Surveillance and Monitoring Plan
	Natural Gas Pipeline	Surface Water	Flow (withdrawal)	During water withdrawal for pressure testing (protect aquatic life)	Plan of Development / Pipeline Surveillance and Monitoring Plan / Temporary Water Use Permit
	Natural Gas Pipeline	Surface Water	Flow (discharge)	During discharge of pressure test water to protect energy-dissipating devices	Plan of Development / Pipeline Surveillance and Monitoring Plan /APDES General Permit
Operations and Maintenance	Project Area surface water sites (sample sites at Anaconda Creek, Crooked Creek below Lyman's Wash Plant, Crooked Creek below Omega Creek, Crooked Creek below Crevice Creek)	Surface water	Water quality (long list[1]), flow	Quarterly	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume III A)

Table 2.3-33: Construction; Operations and Maintenance' and Post-Closure Monitoring Summary

Phase	Component	Media	Parameters	Frequency	Project Plan/Permit
Operations and Maintenance (cont'd)	Project Area surface water sites (sample sites at Anaconda Creek Crooked Creek below Lyman's Wash Plant, Crooked Creek below Omega Creek, Crooked Creek below Crevice Creek)	Aquatic resources	Biomonitoring – fish populations/habitat, periphyton, invertebrates	To be determined	To be determined
	Snow Gulch freshwater reservoir	Surface water	Water quality (long list[1])	Quarterly	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume III A)
	WRF	Visual, seepage flow, operational waste rock sampling	mass stability, static, geochemical characterization, volume placed (monthly)	Weekly (visual), monthly, variable	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume III A) / Integrated Waste Management Waste Rock Management Plan (Donlin Gold Project Plan of Operations Volume III B)
	Lower CWD	Surface water	Water quality (long list[1])	Quarterly	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume III A)
	TSF Embankment	Visual inspections, Stability	Water level, mass stability	Daily, weekly, monthly	Tailings Dam Operations and Maintenance Manual
	TSF Seepage Recovery System	Surface water (seepage)	Water quality (short list[2]) Seepage flow volume	Daily, quarterly	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume III A)

Table 2.3-33: Construction; Operations and Maintenance' and Post-Closure Monitoring Summary

Phase	Component	Media	Parameters	Frequency	Project Plan/Permit
Operations and Maintenance (cont'd)	TSF Seepage Recovery System (Interceptor Wells)	Groundwater	Water quality (long list) Static Water Depth Pumped volume	Daily, weekly, quarterly	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume III A)
	TSF Seepage Recovery System (Compliance Monitoring Wells)	Groundwater	Water quality (long List[1]) Pumped volume	Daily, weekly, quarterly	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume III A)
	ACMA and Lewis Pits (perimeter dewatering wells when discharging from Wastewater Treatment Plant -1 into Crooked Creek via Outfall 001)	Groundwater	Water quality and flow rates to Wastewater Treatment Plant -1	Per APDES permit	APDES permit
	Wastewater Treatment Plant -1 seasonal discharge into Crooked Creek	Surface water	Water quality, flow	Per APDES permit	APDES permit
	Wastewater Treatment Plant sanitary facilities - camp and mine/mill complex Wastewater Treatment Plant -2, Wastewater Treatment Plant -3 discharge into Tailings Storage Facility	Surface water	Water quality, flow	Per State of Alaska waste discharge permit	APDES permit
	Potable water	Water	Free chlorine, bacteria, Trihalomethanes, haloacetic acids, cross-connections	Varies	ADEC requirements/ Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume III A)

Table 2.3-33: Construction; Operations and Maintenance' and Post-Closure Monitoring Summary

Phase	Component	Media	Parameters	Frequency	Project Plan/Permit
Operations and Maintenance (cont'd)	Solid waste landfill	Debris, contents	Visual per waste permit	Weekly (other actions vary)	Integrated Waste Management Plan (Donlin Gold Project Plan of Operations Volume III)
	Mine site	Wildlife	Report presence/mortality observations; water quality sampling (for Weak Acid Dissociable Cyanide with mortality in reclaim pool)	As necessary (report circumstances)	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume III A)
	Overburden, waste rock, ore	Waste Characterization	Acid-Base Accounting	Monthly	Integrated Waste Management Waste Rock Management Plan (Donlin Gold Project Plan of Operations Volume III B)
	Mine Access Road, airstrip, borrow pits, etc. (disturbed areas ≥ one acre)	Storm water	Per SWPPP requirements	Per SWPPP requirements	SWPPP / Construction General Permit (storm water) / Multi-Sector General Permit (storm water) as applicable
	Particulate Matter	Air (visual with instrumentation potential)	Opacity	To be determined	Air permit
	Power Plant Emissions	Air	Startup parameters	Once at startup (commissioning)	Air permit
	Emission Control Vents	Air	Stack testing constituents	To be determined	Air Permit
	Natural Gas Pipeline	Leaks; non-Donlin related construction activity	Occurrences	Twice per year (post breakup and before-deep snowfall); various	Pipeline Surveillance and Monitoring Plan

Table 2.3-33: Construction; Operations and Maintenance' and Post-Closure Monitoring Summary

Phase	Component	Media	Parameters	Frequency	Project Plan/Permit
Operations and Maintenance (cont'd)	Natural Gas Pipeline	River/stream crossings, geohazards, fault crossings, ice-rich permafrost	Stability (erosion, scour, movement)	Twice per year (post breakup and before-deep snowfall); various	Pipeline Surveillance and Monitoring Plan
	Natural Gas Pipeline	Reclamation (vegetation)	Revegetation success, invasive species	Twice per year (post breakup and before-deep snowfall); various	Pipeline Surveillance and Monitoring Plan
	Natural Gas Pipeline	Vegetation (invasive species)	Early Detection Rapid Response	To be determined	Invasive Species Prevention and Management Plan
	Natural Gas Pipeline	Pipeline Integrity	Curvature, position, strain, wall thickness, corrosion	Per Special Permit conditions or as warranted (annually)	Operations and Maintenance Plan/Manual
	Natural Gas Pipeline	Cathodic protection	Integrity	Annually	Plan of Development
	Natural Gas Pipeline	Pipeline valves	Integrity/Functionality	Annually	Plan of Development
	Natural Gas Pipeline	Overpressure safety devices	Functionality	Twice per calendar year	Plan of Development
Closure/Post-Closure	Surface water and groundwater (sample site Crooked Creek below Crevice Creek)	Water	Water quality, flow, static water level	Quarterly first 5 years, annually next 5 years, then once every 5 years	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume III A)
	Tailings Storage Facility Cover	Surface water	Water quality	Quarterly years 6-10	Integrated Waste Management Waste Rock Management Plan (Donlin Gold Project Plan of Operations Volume III B)

Table 2.3-33: Construction; Operations and Maintenance' and Post-Closure Monitoring Summary

Phase	Component	Media	Parameters	Frequency	Project Plan/Permit
Closure/Post-Closure (cont'd)	TSF Seepage Recovery System (Compliance Monitoring Wells)	Groundwater	Water quality Pumped volume	Quarterly first 5 years, annually next 5 years, then once every 5 years	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume III A)
	Pit lake	Surface water	Water level, water quality by depth, water quality of discharge	Varies	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume III A) / APDES Permit once discharging starts
	WRF	Visual, seepage, erosional stability	Water quality, flow, stability	Quarterly first 5 years, annually next 5 years, then once every 5 years	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume III A), Integrated Waste Management Waste Rock Management Plan (Donlin Gold Project Plan of Operations Volume III B)
	Revegetation	Vegetation, reclaimed surfaces	Erosionally stable, biologically self-sustaining	Annually for 5 years or until observations indicate stable conditions	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume III A)
	Mine Access Road and other disturbed facilities areas not fully reclaimed	Storm water	Per SWPPP requirements	Per Storm Water Pollution Prevention Plan requirements	Multi-Sector General Permit (storm water) to extent applicable

Notes:

1 Refers to the Long List of parameters identified in the Donlin Gold Quality Assurance Project Plan Water Quality Monitoring, Sampling, and Analysis Activities (July 2012)
2 Refers to the Short List of parameters identified in the Donlin Gold Quality Assurance Project Plan Water Quality Monitoring, Sampling, and Analysis Activities (July 2012)

Source: SRK 2012d, 2013b.

Closure and Post-closure

During closure and post-closure, the monitoring program for TSF components would include the seepage reclaim system, groundwater monitoring wells, and the LLDPE-lined pond remaining after tailings are covered. As noted above, the goal would be to demonstrate that pond water can be safely discharged to Crevice Creek. The frequency of surface and groundwater sampling would range from quarterly to 5-year intervals depending on the number of years after closure. Discharge water monitoring would continue, depending on compliance history, up to or beyond 30 years after mine closure, or until each component has stabilized, physically and chemically, to the satisfaction of the State of Alaska.

Water in the pit lake would be monitored for 50-55 years after closure or until the pit lake has filled with water. Runoff and seepage from the reclaimed WRF would report to the pit lake after closure. Pit lake monitoring would include water level data collection and water quality sampling at different depths. The pit lake model would be recalibrated as data become available to update estimates of pit filling. Approximately 5 years before the pit water is anticipated to reach an elevation at risk of free flow into Crooked Creek, a WTP would be built at the site. Water would be pumped from the pit to the WTP to maintain the pit as a hydrologic sink (i.e., water level such that groundwater flows towards the pit), and sufficient freeboard is present for high runoff events including a sequence of years with above-average precipitation. The WTP would be operated in perpetuity. Pit lake water quality would be analyzed every 5 years while the pit fills, and monthly while the WTP is operating or per APDES permit requirements.

As well as monitoring the TSF and the pit lake, surface water and groundwater monitoring would continue at closure and post-closure based on approved Reclamation and Closure Plan requirements.

Other Monitoring Programs

Visual inspections during closure and post-closure would include monitoring of the TSF and WRF, mine access road and other remaining non-reclaimed areas for erosion, seepage, and stormwater control in accordance with SWPPP permit requirements. Mass stability inspections of the tailings dam would be conducted according to ADEC requirements; annual inspections would likely be required, and more frequent inspections may also be conducted. Seepage and stormwater inspections of the reclaimed WRF would be carried out every year for 5 years or more after closure, until conditions stabilize, with inspections at least annually in the spring and following storms that exceed the 25-year, 24-hour storm event. Remedial action to correct instability would be taken as soon as feasible following detection of substantial erosion or loss of growth media.

The mine access road and other disturbed facilities that would not be fully reclaimed would be monitored for storm water runoff, as per a SWPPP.

Revegetation progress of reclaimed facilities would be monitored annually for the first 5 years after closure or until observations indicate stabilized conditions. Should vegetative cover not meet criterion established by ADNR, Donlin Gold, and ADF&G, further action could include reseeding the area, additional application of soil amendments, and/or incorporation of additional growth media on a particular site or facility.

2.3.3 ALTERNATIVE 3A – REDUCED DIESEL BARGING: LNG-POWERED HAUL TRUCKS

Alternative 3A would use liquefied natural gas (LNG) instead of diesel to power the large (+300-ton payload) trucks that would move waste rock and ore from the open pits. These large trucks would account for approximately 75 percent of the total annual diesel consumption under Alternative 2. This alternative does not propose using LNG for the trucks hauling cargo and fuel on the mine access road from Angyaruaq (Jungjuk) port.

Alternative 3A would also reduce the barging of diesel fuel to a peak of 19 fuel barge tow round trips per year, compared to the peak of 58 required under Alternative 2. This would result in a 32 percent reduction in peak total river barge traffic. Peak values would be realized late in the mine life.

The primary differences between this alternative and Alternative 2 are the addition of the LNG plant and storage tanks near the processing plant, reduced consumption of diesel, reduced barge trips, reduced on-site diesel storage, and increased natural gas consumption. The description of this alternative was prepared by Donlin Gold (Krall 2013) and subject to independent review by the EIS Team.

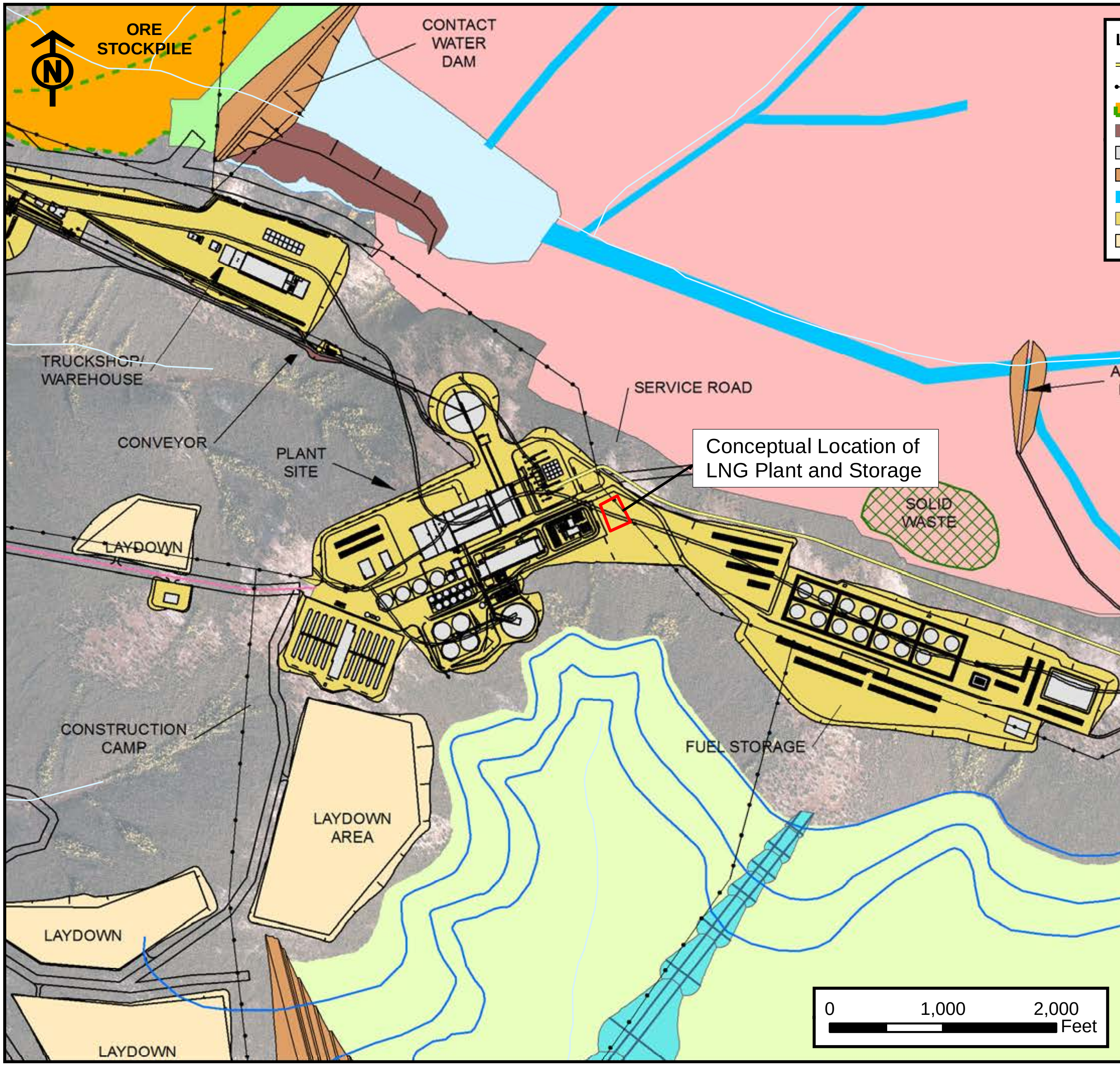
At present, LNG powered haul trucks are not commercially available. However, the technology to use natural gas products (such as LNG or compressed natural gas) in other industrial applications is proven and equipment manufacturers, such as Caterpillar, are actively developing dual fuel (diesel and natural gas) options for the mining industry (Caterpillar 2012). While Caterpillar expects to have equipment such as haul trucks proven commercially available and proven suitable for arctic conditions before mining equipment would be procured, if that did not occur, this alternative would not be feasible.

2.3.3.1 ALTERNATIVE 3A – MINE SITE

For either Alternative 2 or 3A, the natural gas pipeline would approach the project site from the east, run past the fuel and container storage facility and terminate at the power plant. For Alternative 3A, a 220,000-gallon per day LNG plant would be constructed near the terminus of the gas line at the mine site (Figure 2.3-38). Conceptually, the LNG plant would consist of four truckable modules, each about 9 feet by 30 feet and occupy approximately 2,405 sf of land (less than 0.1 acre). LNG would be stored in a series of eight tanks; conceptually, the storage tanks would be 43 feet in diameter and 118 feet long, constructed offsite, shipped using the same river barges and trucks proposed under Alternative 2 and, when installed, occupy approximately 71,732 sf of land (1.6 acres). Distribution and fueling infrastructure would be installed.

The LNG plant, storage containers, and distribution infrastructure footprint would be within an area that would be disturbed under Alternative 2. These LNG-related features would displace some laydown area near the plant site. However, reduced need for diesel storage would allow for displaced laydown capacity to be relocated near the fuel storage area.

Under Alternative 3A, the haul trucks would run on an assumed mix of 95 percent LNG and 5 percent diesel. This would reduce the peak annual diesel consumption from 42.3 Mgal to 13.3 Mgal. Natural gas usage would increase from 11.2 billion standard cubic feet per year (BSCF / year) to 15.5 BSCF / year.



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ALTERNATIVE 3A
LNG PLANT AND STORAGE
TANKS LOCATIONS

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FIGURE 2.3-38

Under Alternative 3A, there would be no other changes to mine site components when compared to Alternative 2. The mining process, WRF, TSF, ore processing, camps, and water use and treatment would not change. Closure, reclamation, and monitoring would be the same as Alternative 2.

2.3.3.2 ALTERNATIVE 3A – TRANSPORTATION FACILITIES (CONSTRUCTION; OPERATIONS AND MAINTENANCE; AND CLOSURE, RECLAMATION, AND MONITORING)

The transportation infrastructure to support mine and pipeline construction and mine operation under Alternative 3A are similar to those under Alternative 2. The LNG facility would be constructed of truckable modules and could be accommodated by the barge trips planned during construction for Alternative 2. The amount of diesel fuel transported by barge to Dutch Harbor, to Bethel and to the Angyaruaq (Jungjuk) Port site storage space would be reduced from a peak of 42.3 Mgal / year to 13.3 Mgal / year, a reduction of about 69 percent.

Under Alternative 3A, fuel sourced from refineries in the Pacific Northwest would be transported to Dutch Harbor by chartered 6.5-Mgal capacity double-hull ocean barges, making two round trips in a shipping season (Table 2.3-34). This would be a reduction from Alternative 2 which would require seven round trips per year. Alternative 2 may indirectly require increased tank storage capacity in Dutch Harbor; under Alternative 3A this would probably not be required.

In Dutch Harbor, the fuel would be pumped ashore to storage tanks, and ultimately into a double-hull 2.94-Mgal capacity ocean fuel barge for delivery to Bethel. Under Alternative 3A it would require five barge trips between Dutch Harbor and Bethel instead of the 14 trips that would be required under Alternative 2. Alternative 2 proposes to build additional diesel storage in Bethel and this could be reduced or eliminated under Alternative 3A.

The number of river barge trips departing Bethel for Angyaruaq (Jungjuk) Port is also reduced under Alternative 3A. This alternative would reduce peak annual Donlin Gold Project related barge traffic, both fuel and cargo, on the Kuskokwim River from an estimated 122 round trips to 83 (approximately 1.1 round trips per day to approximately 0.7 round trips per day). The diesel storage capacity at Angyaruaq (Jungjuk) Port would be reduced. Compared to Alternative 2, tanker truck traffic on the port access road would be the same during construction and reduced by approximately 75 percent during operations.

Table 2.3-34: Estimated Annual Ocean and River Barge Traffic Under Alternative 3A

Barge	Transporting	From	To	Number of Round Trips per season	
				During Construction	During Operation
Ocean	Cargo	Marine Terminals	Bethel	16	12
Ocean	Fuel	Marine Terminals	Dutch Harbor	4	2
Ocean	Fuel	Dutch Harbor	Bethel	4	5
River	Cargo	Bethel	Jungjuk Port Site	50	64
River	Fuel	Bethel	Jungjuk Port Site	15	19

Source: Developed from Krall 2013.

All ocean and river barge dimensions would remain the same as Alternative 2 but fewer barges and tugs would be required. All other transportation facility components such as docks in Bethel and Angyaruaq (Jungjuk), the Angyaruaq (Jungjuk) Port road, and the airstrip would be the same as Alternative 2. There would be fewer trucks hauling diesel on the Angyaruaq (Jungjuk) Port road.

2.3.3.3 ALTERNATIVE 3A – NATURAL GAS PIPELINE

Under Alternative 3A, natural gas usage would increase from 11.2 BSCF/year to a peak of 15.5 BSCF/year. The natural gas pipeline proposed under Alternative 2 has an engineered capacity to accommodate 26 BSCF/year with additional compression (i.e., higher operating pressure) and would not require any modifications to transport the increased amount. Other than increased throughput, the natural gas pipeline component would be identical to Alternative 2.

2.3.4 ALTERNATIVE 3B – REDUCED DIESEL BARGING: DIESEL PIPELINE

Under Alternative 3B, an 18-inch diameter diesel pipeline would be constructed from Cook Inlet to the mine site to reduce diesel barging on the Kuskokwim River. The diesel pipeline would be buried and located in the same corridor proposed for the natural gas pipeline under Alternative 2 (Figure 2.3-14), with an additional 19-mile segment between Tyonek and the start of the proposed corridor for the natural gas line (Michael Baker Jr., 2013a), for a total of 334 miles. This additional segment would cross the Beluga River using HDD. A natural gas pipeline would not be constructed; natural gas would not be used in Alternative 3B.

Alternative 3B would require improvements to the existing Tyonek North Foreland Barge Facility and transportation of diesel fuel in Cook Inlet. It would also require a robust leak detection system and pre-positioned response infrastructure and equipment along the pipeline route.

Alternative 3B would also eliminate the barging of diesel fuel after construction, eliminating the 58 fuel barge tow round trips per year required under Alternative 2. This would result in a 48 percent reduction in total river barge traffic.

The primary differences between this alternative and Alternative 2 are the replacement of the natural gas pipeline with a diesel fuel pipeline, reduced barge trips due to elimination of diesel barging, increased consumption of diesel, and no natural gas consumption. Diesel from the pipeline would be used to fuel the mine's power generation facilities, mobile vehicle fleet, and equipment. The estimated demand for diesel fuel under Alternative 3B is 120 Mgal of diesel per year; there would be no consumption of natural gas for this alternative. In comparison, Alternative 2 would require 42.3 Mgal of diesel and 11.2 BSCF of natural gas per year.

2.3.4.1 ALTERNATIVE 3B – MINE SITE

The infrastructure required at the mine site would be essentially the same as in Alternative 2, with the exception of fuel storage tanks. Under Alternative 2, 37.5 Mgal of diesel (representing 11 months' supply) would be stored at the mine site. Alternative 3B would deliver diesel year round and the on-site storage would be reduced to approximately 10 Mgal (representing 1 month's supply). This would allow some reduction in the spill response equipment prepositioned at the mine site. Under Alternative 3B, there would be no other changes to mine site components when compared to Alternative 2. The mining process, WRF, TSF, ore processing, camps, and water use and treatment would not change. Closure, reclamation, and monitoring would be the same as Alternative 2.

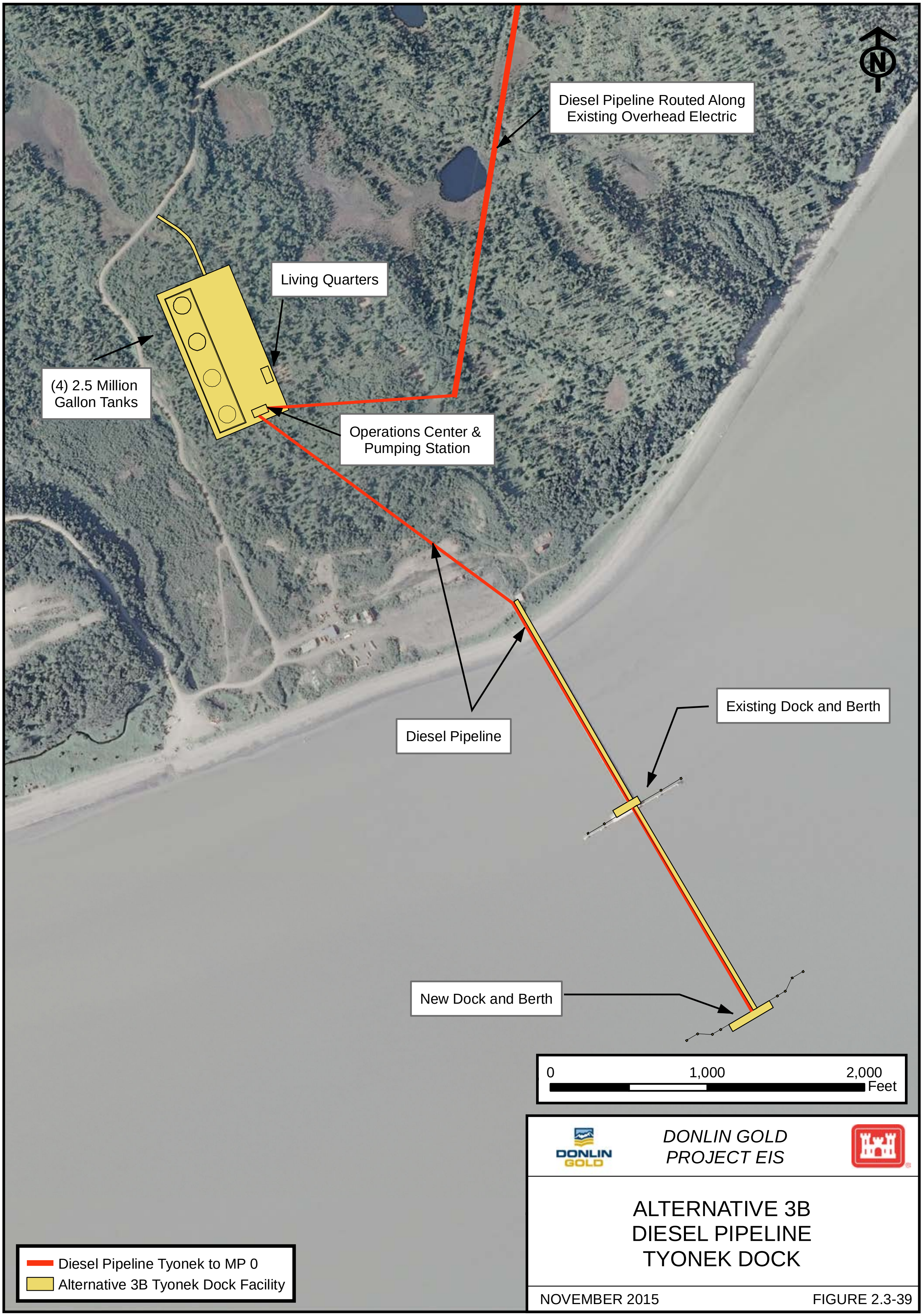
2.3.4.2 ALTERNATIVE 3B – TRANSPORTATION FACILITIES (CONSTRUCTION; OPERATIONS AND MAINTENANCE; AND CLOSURE, RECLAMATION, AND MONITORING)

The transportation facilities to support mine and pipeline construction and mine operation under Alternative 3B are similar to those under Alternative 2. Delivery of diesel to the mine site during construction would also be similar to Alternative 2.

Diesel fuel would be transported directly from the Pacific Northwest or from the Tesoro refinery in Nikiski to Tyonek via chartered 10.5 Mgal capacity tankers, making an estimated 12 round trips annually. The existing dock at the Tyonek North Foreland Facility currently extends 1,500 feet from shore to a water depth of approximately 21 feet. The dock would need to be extended an additional 1,500 feet to accommodate vessels in excess of 30,000 gross tons, and a fuel unloading system would need to be installed (see Figure 2.3-39).

Fuel delivery via tanker to the Tyonek North Forelands Facility would occur year round. Storms, extreme tides, icing and strong currents are continual challenges to safe navigation. In addition, tankers berthed during winter months must be able to withstand the increased ice load. Fuel transfers under conditions experienced at the Tyonek facility have the potential for spills and other risks during docking procedures. The use of tug boats would reduce the risk of grounding; however, the west side of Cook Inlet does not have mooring facilities for tugs. Tug boat support would likely come from Kenai, Nikiski, or Anchorage on the east side of Cook Inlet. Similar tank ships of this capacity regularly berth at Nikiski docks on the east side of Cook Inlet. These vessels include the *Overseas Nikiski*, *Overseas Martinez*, and *Overseas Boston*. These vessels are 600 feet long, 105 feet wide, with drafts of 40 feet. Water depth at the face of the extended dock would need to be about 45 feet mean lower low water (MLLW) to allow for the vessel draft and design clearance to the floor of Cook Inlet at low tide levels.

A new tanker berth and pile support system would be designed to accommodate site-specific tide, ice, seismic risk, and sea bottom conditions. The berth would likely consist of multiple-pile moorings designed to hold vessels in place during all tides, currents, winds, and ice conditions within the design ranges for continuous 24-hour operation. A bathymetric survey would be completed prior to design and construction. Large boulders protruding above the sea floor shown on navigation charts would present navigation hazards and would need to be identified and removed. Because the dock would be extended to the design water depth, it would not be necessary to have traditional dredging at the dock or in shipping channels, either initially or for maintenance. A temporary barge landing would be constructed on the beach adjacent to the dock to support construction of the pipeline and dock extension. It’s assumed that tug support for berthing would be provided by vessels already operating out of Nikiski, Kenai or Anchorage.



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ALTERNATIVE 3B
DIESEL PIPELINE
TYONEK DOCK

NOVEMBER 2015

FIGURE 2.3-39

Alternative 3B would reduce peak annual Donlin Gold related river barge traffic on the Kuskokwim River to 64 trips, which would be exclusively for cargo transit (see Table 2.3-35). (Alternative 2 would require an estimated 122 river barge round trips per year.) Transport of diesel by tank truck on the mine access road would be the same as Alternative 2 during construction but would be reduced by more than 75 percent during operations.

Table 2.3-35: Estimated Annual Ocean and River Barge Traffic Under Alternative 3B

Barge	Transporting	From	To	Number of Round Trips per season
Ocean	Fuel	Marine Terminals in Pacific Northwest to include Seattle, WA and/or Vancouver, B.C., or from Tesoro Refinery in Nikiski	Tyonek	12
Ocean	Cargo	Marine Terminals	Bethel	16 during construction 12 during operation
River	Cargo	Bethel	Angyaruaq (Jungjuk) Port Site	64

Source: Michael Baker Jr. 2013a, SRK 2013a

Spill response strategies would be similar to Alternative 2 for the transportation facilities but with the reduction in storage volume, the amount of pre-staged response equipment could be reduced. Other transportation facility components to support cargo shipments, such as docks in Bethel and Angyaruaq (Jungjuk), the mine access road, and the airstrip would be the same as Alternative 2. The diesel storage capacity in Dutch Harbor, Bethel and at Angyaruaq (Jungjuk) Port would not be required for Alternative 3B, except that some fuel would be required during construction before the pipeline is operational. Transportation facilities such as helipads, airstrips, or road segments that would be maintained for spill response are discussed below in the pipeline description. A permanent road would not be provided along the entire pipeline route.

2.3.4.3 ALTERNATIVE 3B – DIESEL PIPELINE

Under Alternative 3B, a 334-mile long, 18-inch diameter buried diesel pipeline would be constructed. The pipeline would be capable of delivering 120 Mgal of fuel per year, or about 329,000 gallons of fuel per day. The ROW and construction techniques would be similar to those proposed for the natural gas pipeline and described in detail above for Alternative 2. A natural gas pipeline would not be constructed; natural gas would not be used in Alternative 3B.

The proposed diesel pipeline corridor would begin at the Tyonek dock at the north end of Cook Inlet and extend to MP 0 of the Alternative 2 natural gas pipeline. The remainder of the route follows the same alignment proposed for the natural gas pipeline in Alternative 2. Figure 2.3-40 shows the 18-mile segment between Tyonek and the beginning of the natural gas pipeline route (under Alternative 2) that would be followed for the diesel pipeline.

The diesel pipeline would be operated as an ambient line (i.e., the pipe temperature would generally be within a few degrees of the ground temperature and should not freeze surrounding thawed soils); therefore the line would not likely be impacted by frost heave. Any thaw settlement would most likely be the result of surface disturbance caused by construction activities (i.e., clearing of vegetation and stripping of organics along the pipeline right-of-way [ROW]) and not attributed to the pipeline.

The 18-inch diesel pipeline would have a similar diameter and wall thickness to the base case natural gas line described in Alternative 2, and therefore should have similar response to ground deformations caused by various geohazards. Based on preliminary analyses conducted for the base case gas line, the diesel line should be able to accommodate up to approximately 1-foot of movement without any special requirements. The pipeline alignment crosses the Castle Mountain and Denali seismic fault lines and, like the base case gas line, would be constructed above grade in these areas.

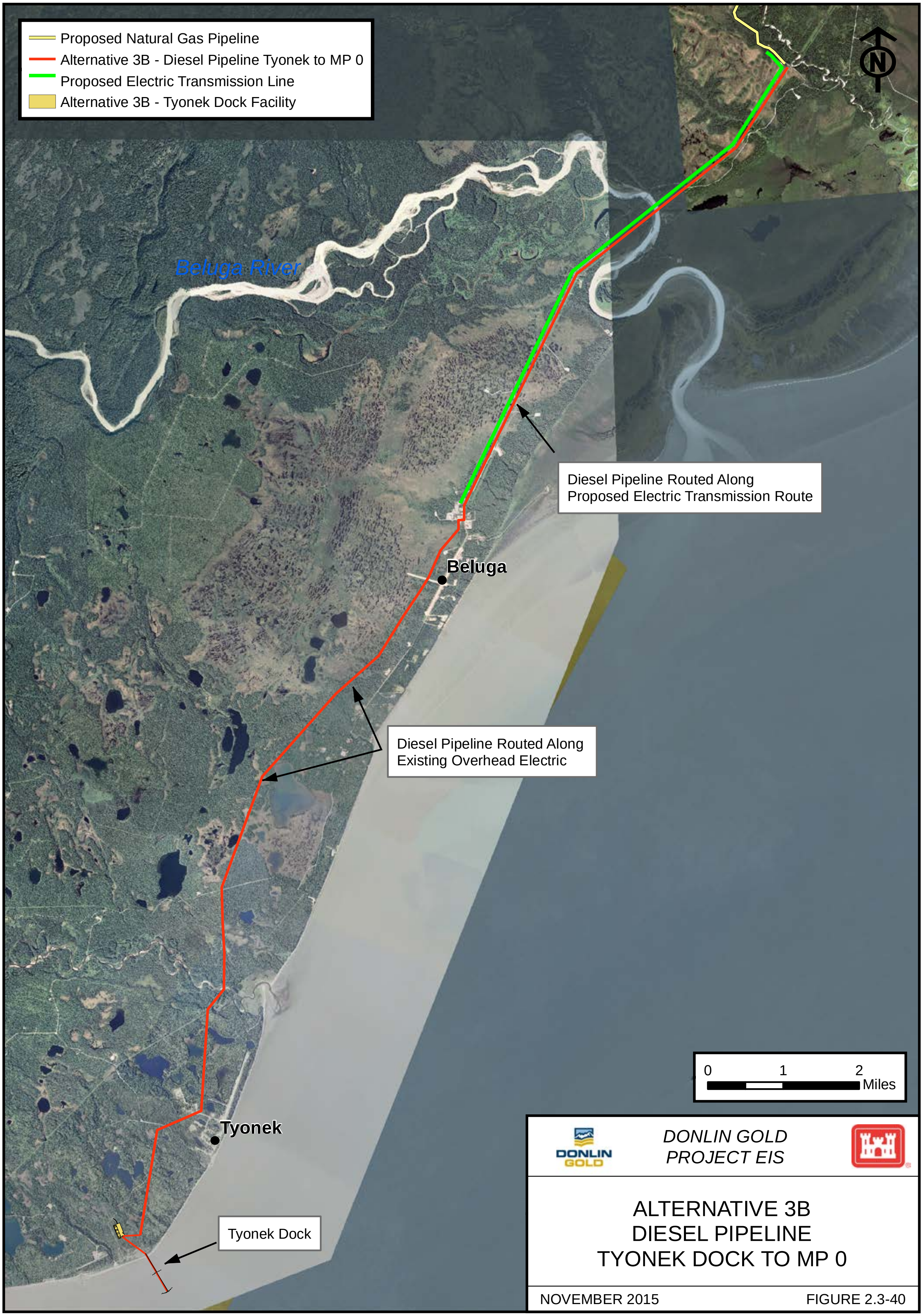
This alternative requires construction of a new Operations Center and Pumping Facility in the uplands near the dock at Tyonek. The facility would contain meters, pumps, and a pig launcher where in-line maintenance and inspection tools would be deployed. The operations center would include living quarters for on-site personnel, a water well, and a sewer septic system. The facility would be connected to the local Chugach Electric grid for power. Overhead distribution lines from the local Chugach Electric grid currently provide power to the area. Installation of 10 miles of additional lines from the Beluga Power plant could be required to supply power required for the pumping facility. While upgrades to existing utility poles could be required for the additional lines, it is unlikely that parallel lines would be required.

A new tank farm consisting of four 2.5-Mgal above-ground storage tanks would be designed to store a one month supply of diesel fuel and would be co-located with these facilities. A spill containment system would be constructed around the fuel tanks.

Manual block valves would be installed on each bank at 27 stream crossing locations where the bank-full width of the stream exceeds 100 feet. In addition, check valves would be installed on the downstream side of each crossing to provide added protection. Of the 237 total drainage crossings along the entire pipeline route, 210 would not require installation of isolation valves.

For the diesel pipeline, a leak detection and spill response plan would be developed for review and approval by ADEC. Section 3.24, Pipeline Reliability and Safety, of this EIS describes spill risk associated with the project including risks from the diesel pipeline alternative. A software-based leak detection system would be installed with connection to the operations center. Regular over-flights to monitor the pipeline would be required.

For the diesel pipeline some of the construction infrastructure would be required to remain through operations to provide for a reasonable diesel spill response capability. Spill response techniques are provided in Section 3.24. Spill response requirements and equipment storage locations would necessitate maintaining some of the construction facilities and most of the airstrips in a usable condition throughout the operating life of the pipeline. Modifications may be required to some of the proposed airstrips to make them suitable for multi-season (as opposed to just winter) use and additional Hercules C- 130 capable airstrips and staging areas would be required (see Table 2.3-36). The airstrips required for spill response capacities include the nine new airstrips proposed as facilities to support construction in Alternative 2 (See Table 2.3-28), plus three additional Donlin Gold proposed airstrips: Puntilla Airstrip, Tatlawiksuk Airstrip, and George River Airstrip.



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ALTERNATIVE 3B
DIESEL PIPELINE
TYONEK DOCK TO MP 0

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FIGURE 2.3-40

Table 2.3-36: Airstrips for Alternative 3B

Location (MP)[1]	Near Airstrip	Airstrip Class	Airstrip Length (ft)	Hercules Capable	Distance off Alignment (miles)
MP 16	Tyonek	Existing Airstrip (FAA)	5,163	Y	0.4
MP 8	Beluga	Existing Airstrip (FAA)	5,035	Y	0.2
MP 14	Little Susitna	Existing Airstrip (FAA)	2,800	N	21.5
MP 27	Jewell	Existing Airstrip (FAA)	1,900	N	12.8
MP 42	Deep Creek Airstrip	Airstrip (Proposed Donlin)	3,500	N	0.0
MP 50	Skwentna	Existing Airstrip (FAA)	4,022	N	8.0
MP 54	Shell Airstrip	Airstrip (Proposed Donlin)	5,000	Y	0.2
MP 85	Happy River Airstrip	Airstrip (Proposed Donlin)	5,000	Y	0.1
MP 101	Rainy Pass	Existing Airstrip (FAA)	2,359	N	0.3
MP 108	Puntilla Airstrip	Airstrip (Proposed Donlin)	5,577	Y	0.3
MP 111	Threemile Airstrip	Airstrip (Proposed Donlin)	3,500	N	0.2
MP 131	Tatina	Existing Airstrip (FAA)	2,230	N	8.0
MP 133	Bear Paw Airstrip	Airstrip (Proposed Donlin)	4,000	N	0.1
MP 144	Jones Airstrip	Airstrip (Proposed Donlin)	5,000	Y	0.9
MP 149	Tin Creek	Existing Airstrip (FAA)	2,700	N	2.0
MP 158	Farewell Airstrip	Existing Airstrip (FAA)	5,000	Y	2.8
MP 158	Nikolai	Existing Airstrip (FAA)	4,500	N	40.9
MP 170	Medfra	Existing Airstrip (FAA)	2,540	N	50.5
MP 191	Big River Airstrip	Airstrip (Proposed Donlin)	5,000	Y	0.5
MP 200	McGrath	Existing Airstrip (FAA)	6,000	Y	53.1
MP 220	Tatlawiksuk Airstrip	Airstrip (Proposed Donlin)	6,500	Y	0.2
MP 235	Kuskokwim East Airstrip	Airstrip (Proposed Donlin)	5,000	Y	1.4
MP 246	Kuskokwim West Airstrip	Airstrip (Proposed Donlin)	5,000	Y	0.2
MP 258	Stony River	Existing Airstrip (FAA)	3,048	N	19.0
MP 272	Sleetmute	Existing Airstrip (FAA)	3,480	N	21.8
MP 273	Red Devil	Existing Airstrip (FAA)	5,233	Y	17.9
MP 276	George River Airstrip	Airstrip (Proposed Donlin)	5,000	Y	0.8
MP 315	Crooked Creek	Existing Airstrip (FAA)	2,520	N	10.2
MP 315	Aniak	Existing Airstrip (FAA)	6,600	Y	54.7
MP 315	Chuathbaluk	Existing Airstrip (FAA)	3,900	N	46.3

Notes:

1 Mileposts are the same as Alternative 2 Natural Gas Pipeline except that the additional segment to Tyonek is shown as negative mileposts from the Alternative 2 beginning.

FAA = Federal Aviation Administration ft = feet MP = milepost

Source: Polaris 2014.

Portions of gravel road developed during construction may be left in place to facilitate movement along the pipeline ROW in select areas. Spill response to and source control at the pipeline would benefit tremendously if the temporary construction gravel roads could be kept available post-construction. These roads in combination with the maintained ROW would provide overland access, mainly during summer, but also to small pipeline segments during the winter.

To adequately respond to diesel spills, equipment such as containment boom, skimmers, portable tanks, absorbent materials, four-wheelers, snow machines, boats, rafts, and vacuum equipment would likely be staged at major streams, at the dock facility, tank farms, and other strategic locations along the pipeline corridor. Response materials would be delivered by air from such locations to multiple deployment sites along the affected area or receiving water body.

Conceptually, initial spill response equipment would be staged at the 27 designated large drainages along the pipeline corridor, at the dock facility, and at the tank farms. Donlin Gold would strategically place the spill response equipment at these sites based on location, accessibility, terrain, and stream morphology.

2.3.5 ALTERNATIVE 4 – BIRCH TREE CROSSING (BTC) PORT

Alternative 4 would move the upriver port site from Angyaruaq (Jungjuk) (under Alternative 2) to Birch Tree Crossing (BTC), located about 124 river miles upriver from Bethel. This would reduce the barge distance for freight and diesel out of Bethel bound for the mine site from 199 miles to Angyaruaq (Jungjuk) Port versus 124 miles to BTC, a decrease of 75 miles or 38 percent. The same volume of cargo and diesel fuel would be transported by barge as in Alternative 2. The BTC mine access road would be 76 miles long, versus 30 miles for the mine access road from Angyaruaq (Jungjuk) Port, an increase of 46 miles and 153 percent in distance.

There would be no other substantive changes to other project components as described for Alternative 2.

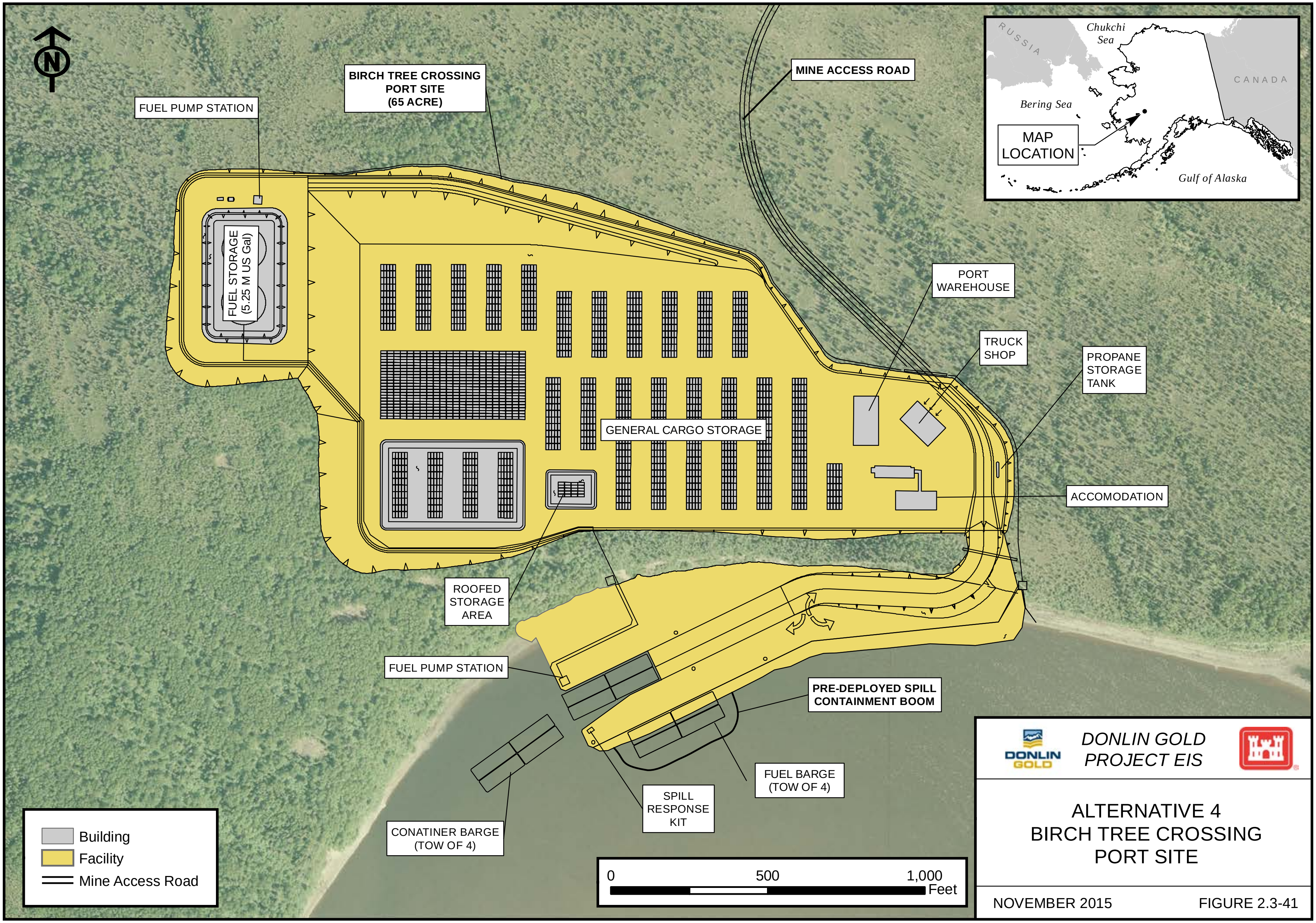
2.3.5.1 ALTERNATIVE 4 – MINE SITE

The mine site activities for Alternative 4 would be the same as Alternative 2.

2.3.5.2 ALTERNATIVE 4 – TRANSPORTATION FACILITIES (CONSTRUCTION; OPERATIONS AND MAINTENANCE; AND CLOSURE, RECLAMATION, AND MONITORING)

Alternative 4 would move the upriver port site from Angyaruaq (Jungjuk) to BTC. Barges procured by Donlin Gold would not travel between BTC and Angyaruaq (Jungjuk). The river depth up to BTC is more favorable, since the limiting river depth is about 1 foot shallower in the channels between BTC and Angyaruaq (Jungjuk) than downriver of BTC. Three villages along the Kuskokwim River would experience less barge traffic under this alternative.

The 65-acre port site would be situated on the Kuskokwim River, (Figure 2.3-41). The site consists of an onshore pad area and a filled area in the river to allow container barges to dock. The onshore pad includes areas for general storage, fuels storage, warehouse truck shop and living accommodations. The site is larger than Alternative 2 for two reasons: 1) the nature of



N
BIRCH TREE CROSSING PORT SITE (65 ACRE)
FUEL PUMP STATION
MINE ACCESS ROAD
FUEL STORAGE (5.25 M US Gal)
PORT WAREHOUSE
TRUCK SHOP
PROPANE STORAGE TANK
GENERAL CARGO STORAGE
ACCOMODATION
ROOFED STORAGE AREA
FUEL PUMP STATION
PRE-DEPLOYED SPILL CONTAINMENT BOOM
FUEL BARGE (TOW OF 4)
SPILL RESPONSE KIT
CONATINER BARGE (TOW OF 4)
Chukchi Sea
RUSSIA
CANADA
Bering Sea
MAP LOCATION
Gulf of Alaska
Building
Facility
Mine Access Road
0
500
1,000
Feet
DONLIN GOLD
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ALTERNATIVE 4
BIRCH TREE CROSSING PORT SITE
NOVEMBER 2015
FIGURE 2.3-41

the terrain and the high bluff results in a much larger footprint to get the required laydown area, and 2) because of the longer haul road distance (~2.5 times that from Jungjuk) it is considered impractical to haul all the consumables up the road within the barging season and the port and road would have to be operated for a longer period to get all consumables transferred to the mine site. As such, more space is needed to store consumables as they build up at the BTC site until they can be moved to the mine site.

An approximately 76-mile, 30-foot wide, all season gravel access road would link the BTC port site to the Donlin Gold Project site (Figure 2.3-42). The road would be used for transporting fuel and cargo for the project, and would be about 2.5 times longer than the mine access road proposed for Alternative 2. It would cross lands owned by TKC. Public use of the road would not be allowed. The number of cargo trucks and tanker trucks would be the same as Alternative 2, but the time on the road would increase.

Fifty material sites would be used to provide materials to construct the gravel road from BTC to the mine (Table 2.3-37).

Table 2.3-37: Material Sites – BTC Road

Material Site	MP nearest BTC Road	Area (acres)	Material Type	Volume (m^3)
MS 01	2	34.8	Granodiorite	1,000,000
MS 02	3.5	18.8	Sedimentary rock	300,000
MS 03	5.5	5.9	Sedimentary rock	50,000
MS 04	7.5	8.4	Sedimentary rock	80,000
MS 05	8	24.7	Rhyolite	200,000
MS 06	10	5.2	Rhyolite	50,000
MS 07	12.5	22.0	Rhyolite	50,000
MS 08	13.5	42.0	Granodiorite	300,000
MS 09	14	4.9	Rhyolite	50,000
MS 10	16	205.3	Gravel	1,500,000
MS 14	31.5	33.6	Basalt	250,000
MS 15	32	10.4	Sedimentary rock	50,000
MS 16	12	38.3	Rhyolite fractured	300,000
MS 17	15	44.7	Rhyolite fractured	400,000
MS 18	15.5	51.9	Sedimentary & rhyolite	500,000
MS 19	16.5	47.4	Sedimentary rock	300,000
MS 20	18.5	29.7	Sedimentary rock	250,000
MS 21	20	40.5	Sedimentary rock	250,000
MS 22	20.5	39.5	Sedimentary rock	250,000
MS 23	21.5	39.5	Sedimentary rock	250,000
MS 24	23.5	49.4	Sandstone, broken	500,000

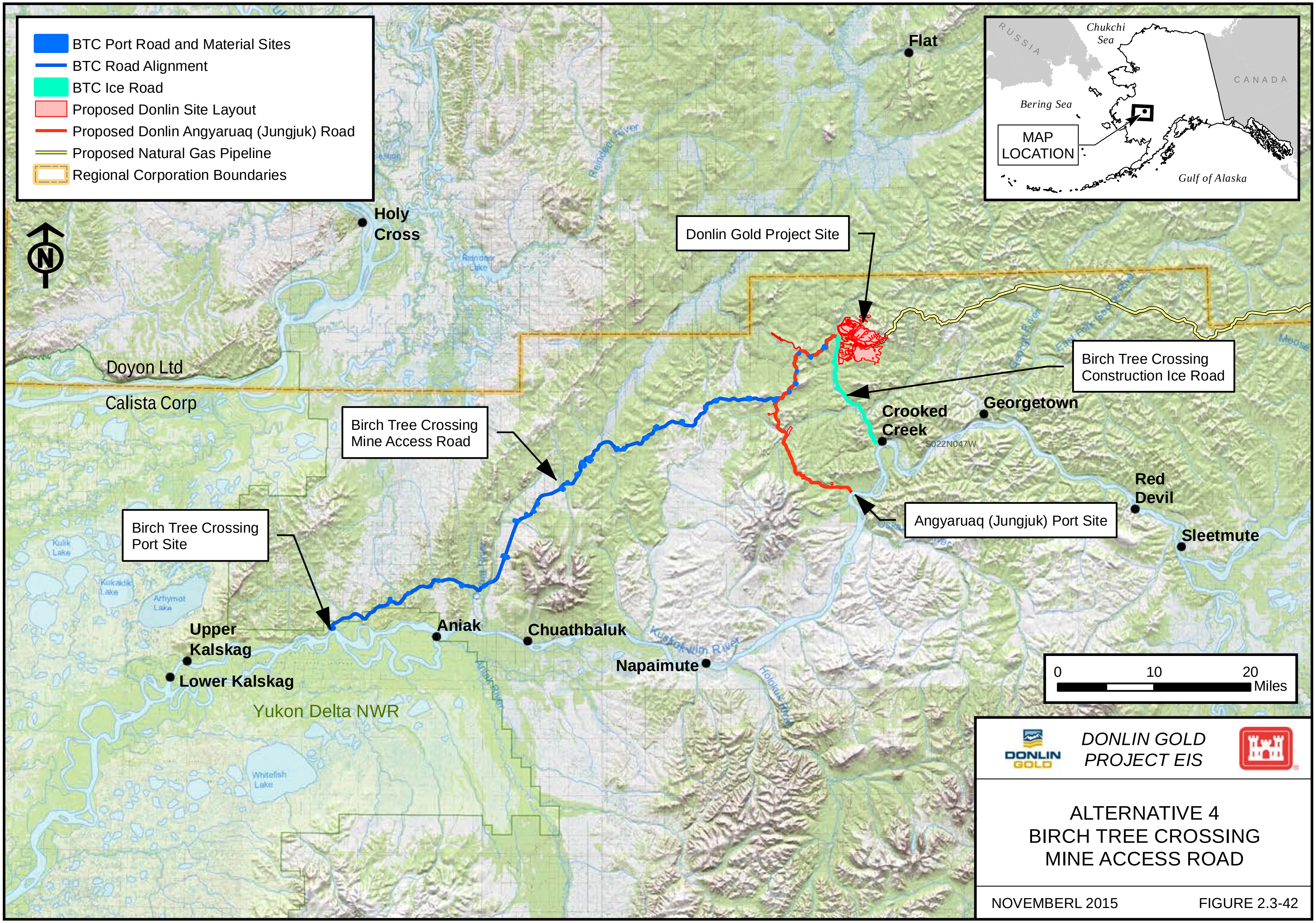
Table 2.3-37: Material Sites – BTC Road

Material Site	MP nearest BTC Road	Area (acres)	Material Type	Volume (m^3)
MS 25	26	49.4	Basalt	300,000
MS 26	28	51.6	Sedimentary rock	250,000
MS 27	30.5	24.2	Sandstone, broken	200,000
MS 28	31.6	37.8	Sandstone, slabby	500,000
MS 29	35.5	73.4	Sandstone, slabby	300,000
MS 30	36.5	63	Sandstone, slabby	300,000
MS 31	38	45.2	Sedimentary rock	200,000
MS 32	39.5	22.5	Sedimentary rock	150,000
MS 33	40	12.6	Sandstone	150,000
MS 34	40.5	42.5	Gravel	150,000
MS 35	43.5	28.9	Sedimentary rock	250,000
MS 36	44.5	10.9	Sandstone, broken	80,000
MS 37	45	21.0	Gravel	80,000
MS 38	46.5	27.4	Gravel	150,000
MS 39	50.5	67.5	Gravel	300,000
MS 40	53.5	5.4	Gravel	40,000
MS 41	54.5	17.5	Sedimentary rock	250,000
MS 42	57	30.6	Sedimentary rock	250,000
MS 43	58	17.1	Sedimentary rock	100,000
MS 44	60	14.1	Sedimentary rock	100,000
MS 45	62	10.6	Sedimentary rock	130,000
MS 46	64	17.8	Basalt	180,000
MS 47	64.5	11.6	Basalt	100,000
MS 48	66.5	30.4	Basalt	300,000
MS 49	68	5.7	Sedimentary rock	25,000
MS 50	69.5	25	Sedimentary rock	20,000
MS 51	71	25	Sedimentary rock	30,000
MS 52 BTC Port site	73	49.4	Conglomerate	1,500,000
Total	N/A	1,635	N/A	13,265,000

Notes:

BTC = Birch Tree Crossing
m^3 = cubic meters
MP = milepost
MS = material site

Source: RECON 2007a.



ALTERNATIVE 4
BIRCH TREE CROSSING
MINE ACCESS ROAD

NOVEMBERL 2015

FIGURE 2.3-42

The BTC road would cross 40 water bodies or floodways; 8 of which would require bridges and 32 would require culverts (see Table 2.3-38).

Table 2.3-38: BTC Road Stream Crossings

Stream Name	MP Nearest BTC Road	Crossing Type	Bridge Span (ft)	Culvert Diameter (in)
Crooked Creek Floodway #1	0	culvert		48
Crooked Creek Floodway #2,	0	culvert		72
Crooked Creek	0	bridge	82	
Crooked Creek Floodway #3	0	culvert		72
Crooked Creek Floodway #4	0	culvert		48
Skanky Creek	29	culvert		96
Iditarod River	33.5	bridge	49	
Unnamed	36	culvert		60
Unnamed	36.5	culvert		60
Karst Creek	38.5	culvert		96 + 36 for overflow
Cala Poco Creek	39.5	culvert		72
Cobalt Creek	40	bridge	49	
Dunamis Creek	41.5	culvert		96 + 36 for secondary channel
Unnamed	42	culvert		48
Unnamed	42.5	culvert		48
Lithos Creek	44.5	culvert		96
Unnamed	46	culvert		48
Tyrel Creek	46.5	bridge	39	
Unnamed	47	culvert		48
Unnamed	48	culvert		48
Unnamed	49	culvert		48
Unnamed	49.5	culvert		48
Unnamed	50	culvert		48
Jubil Creek	50	bridge	32	
Random Creek	52	culvert		96
Unnamed	53	culvert		48
Unnamed	53	culvert		48
Owhat River	54	bridge	82	
Owhat Floodway #1	54	culvert		84 x 2
Owhat Floodway # 2	54	culvert		84
Unnamed	54.5	culvert		72

Table 2.3-38: BTC Road Stream Crossings

Stream Name	MP Nearest BTC Road	Crossing Type	Bridge Span (ft)	Culvert Diameter (in)
Kaina Creek	56.5	bridge	39	
Tor Creek	59.5	culvert		84
Unnamed	62	culvert		48
Unnamed	62.5	culvert		60
Unnamed	66	culvert		60
Aurum Creek	66	culvert		60
Ploutos Creek	71	culvert		84
Ones Creek	71.5	bridge	49-59	
Unknown	73	culvert		96

Notes:

BTC = Birch Tree Crossing
MP = milepost

Source: Recon 2007a.

Construction of the BTC road would require the installation of a temporary ice road from the vicinity of the Village of Crooked Creek to the mine site to allow construction of the BTC road from both ends. The spur roads off of the main access road near the mine site would run to the proposed airstrip and permanent camp facilities. The ice road would cross land owned by TKC and the State of Alaska. If this alternative was selected, Donlin Gold would identify water sources and acquire necessary permits for water withdrawal for ice road construction.

Port and road construction techniques would be the same as or very similar to those described for Alternative 2. Maintenance and post-mine decommissioning would be the same.

While there are fewer river miles between Bethel and BTC, the truck haul distance means that additional cargo and fuel tanker trucks would be needed for transporting materials to the mine site.

Positioning the upriver port site at BTC rather than Angyaruaq (Jungjuk) would not materially change on the total volume of cargo and fuel shipped from the Pacific Northwest to Bethel and on to the mine site. The estimated annual ocean and river barge traffic (in terms of number of trips) is the same for both Alternative 2 and Alternative 4.

2.3.5.3 ALTERNATIVE 4 – NATURAL GAS PIPELINE

The natural gas pipeline under Alternative 4 would be identical to Alternative 2.

2.3.6 ALTERNATIVE 5A – DRY STACK TAILINGS

Alternative 5A would evaluate an alternate tailings method, using the dry stack tailings (DST) instead of the conventional subaqueous tailings storage that would be used under Alternative 2. This alternative would use filter-presses and vacuum-filters to increase the solid content to more than 80 percent. This alternative was suggested during scoping to avoid the perceived risk of releases from the tailings dam proposed under Alternative 2.

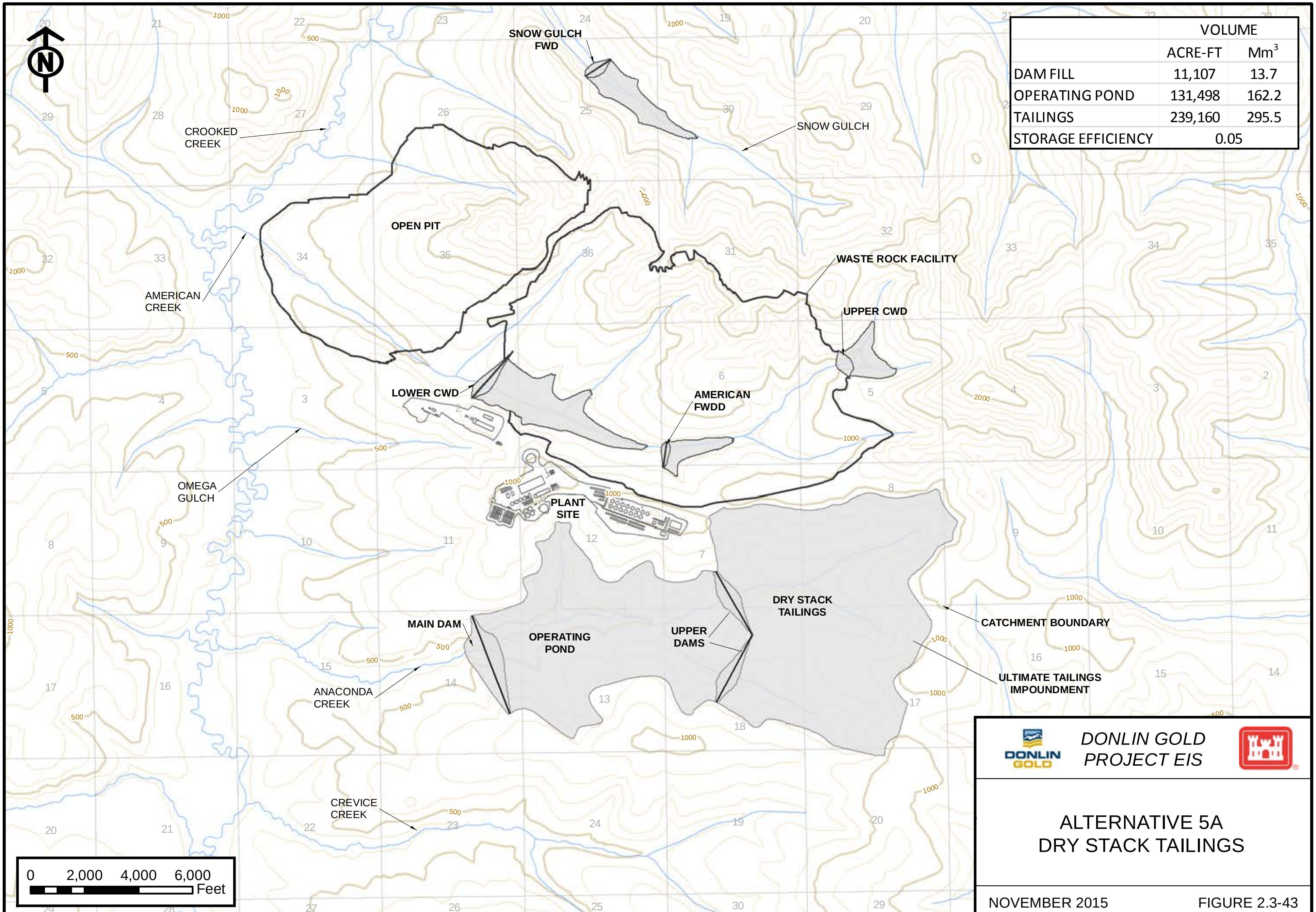
2.3.6.1 ALTERNATIVE 5A – MINE SITE

Under Alternative 5A, tailings would be dewatered in a filter plant using specialized equipment to produce a partially saturated, compactable filter cake, referred to as DST. This material would be delivered to the dry stack TSF by truck and spread and compacted in thin layers using bulldozers. The total volume of filtered tailings that would be produced is approximately 239,500 acre-ft. Residual process water removed from the tailings would be transported to an operating pond via pipeline. Reclaim water from the operating pond would be pumped back to the process plant for reuse. A small volume of off-specification tailings that are not filterable would be directed to the operating pond.

The dry stack TSF and operating pond would be located in the Anaconda Creek Valley in the same general location as under Alternative 2. Under Alternative 5A, the TSF would comprise a main dam and two upper dams that split the valley into two cells (see Figure 2.3-43). The main dam would have a maximum height of 367 feet and would contain the operating pond. The upper dams would separate the pond from the DST (to keep water from entering the dry stack), and the taller upper dam would be 218 feet high. The main dam, upper dams, and operating pond would be fully lined with a 60-mil (1.5 mm) LLDPE liner.

This alternative includes two options:

- Option 1: The dry stack TSF would not be lined with an LLDPE liner. The area would be cleared and grubbed and an underdrain system placed in the major tributaries under the dry stack TSF and operating pond to intercept groundwater base flows and infiltration through the dry stack and convey it to an SRS. The underdrain system would be extended upstream as the dry stack footprint increased over time. Flows collected in the dry stack underdrains will be conveyed beneath the upper dam, the operating pond liner and the main dam before discharging to the SRS collection pond. Water collecting in the SRS pond would be pumped to the operating pond, lower CWD, or directly to the process plant for use in process.
- Option 2: The dry stack tailings would be underlain by a pumped overdrain layer throughout the footprint, with an impermeable LLPDE liner below. The rock underdrain and foundation preparation would be completed in the same manner as Option 1.
- The tailings would be spread and compacted in lifts, creating a “dry stack” that would be approximately 412 feet high and extend a maximum length of 1.6 miles from the upper dam crest. The finished surface of the tailings would be sloped towards the operating pond to allow collection of contact water. A collection and diversion system would divert non-contact surface water away from the tailings. DST mobilized from the stack in runoff would be contained behind the upper dams. The footprints of the operating pond impoundment and the dry stack tailings pile would be approximately 1,070 acres and 1,393 acres, respectively at the conclusion of mining. The ultimate combined operating pond and dry stack footprint would be 2,463 acres. By comparison, the Alternative 2 combined TSF and operating pond footprint would be 2,394 acres at the conclusion of mining.



	VOLUME	
	ACRE-FT	Mm^3
DAM FILL	11,107	13.7
OPERATING POND	131,498	162.2
TAILINGS	239,160	295.5
STORAGE EFFICIENCY	0.05	

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ALTERNATIVE 5A
DRY STACK TAILINGS

NOVEMBER 2015

FIGURE 2.3-43

- During closure, the tailings would be covered with soil, an LLDPE cover, and vegetated. The cover would be graded to the southeast to direct surface runoff to Crevice Creek.

At closure, the operating pond water and any residual solids would be pumped to the open pit. The operating pond and main dam liners would be removed, the dam walls would be breached and graded back into the footprint, and the footprint reclaimed. The SRS would be relocated to be downstream of the upper dams to collect contact water infiltrating through the dry stack cover and water collected in the underdrains. Water from the SRS would be sent to the open pit. After Year 10 of closure, it is anticipated that surface water from the cover will be of suitable quality for discharge and will be permitted to drain to Crevice Creek.

Operationally, the DST method adds complexity when compared to Alternative 2. There is no precedent in current mining operations for using the dry stack tailings method at this production rate. The production rate would be three times larger than the current largest facility (La Coipa, Chile in an arid climate) and 24 times larger than the current largest facility in a sub-arctic climate (Pogo Mine in Alaska) (BGC 2013g). Specialized filtering equipment would be required and considerable test work would be required to determine the feasibility of filtering fine tailings at the proposed throughput rate of 59,000 tons per day. A subarctic climate introduces additional operational complexities in delivery and deposition of the dry stack tailings, because the residual water content in the tailings would freeze in transit unless the haul truck beds are heated. Truck beds, heated with exhaust gas, are proposed as a solution. Nine additional 150-ton capacity haul trucks would be required for the dry stack tailing delivery and deposition, along with additional dozers, graders, and soil compactors to distribute and consolidate the tailings.

The filter plant for Alternative 5A is expected to lead to a 2 percent increase in power consumption. Additionally, for Alternative 5A, the amount of exposed tailings would be increased by 70 acres at the end of Year 1 and 560 acres at Year 23 when compared to Alternative 2. Dust control would include rotating work/deposition fronts, using barriers such as silt fences, and spraying with binders such as Entac or equivalent.

2.3.6.2 ALTERNATIVE 5A – TRANSPORTATION FACILITIES

The transportation facilities under Alternative 5A would be identical to Alternative 2. Alternative 5A would require additional filter plant infrastructure and consumables, along with additional earth moving equipment (to transport and compact the tailings and diesel fuel. Transporting these items to the mine site would require an estimated additional seven barge tows per year on average, for an annual total of 129 round trips, an increase of 6 percent.

2.3.6.3 ALTERNATIVE 5A – NATURAL GAS PIPELINE

The natural gas pipeline under Alternative 5A would be identical to Alternative 2. The volume of natural gas shipped in the pipeline would be increased approximately 2 percent to fuel the filter plant.

2.3.7 ALTERNATIVE 6A – MODIFIED NATURAL GAS PIPELINE ALIGNMENT: DALZELL GORGE ROUTE

Alternative 6A, Dalzell Gorge Route, would realign the natural gas pipeline between MP 106.5 to 152.7, a distance of 46.2 miles, or 14.6% of the Alternative 2 pipeline alignment. The pipeline ROW under Alternative 6A would be slightly shorter, at 313 miles, compared to 315 for Alternative 2. In the affected segment, the Alternative 6A alignment would be to the west of the proposed action and would traverse Dalzell Gorge. This segment was originally part of the proposed action in the 2012 Plan of Development (POD) but would be bypassed by the alignment presented in the 2013 POD (SRK 2012i and SRK 2013b). This alternative route is carried forward for analysis because it is feasible and would allow comparison of environmental impacts to Alternative 2.

2.3.7.1 ALTERNATIVE 6A – MINE SITE

The mine site facilities under Alternative 6A would be identical to Alternative 2.

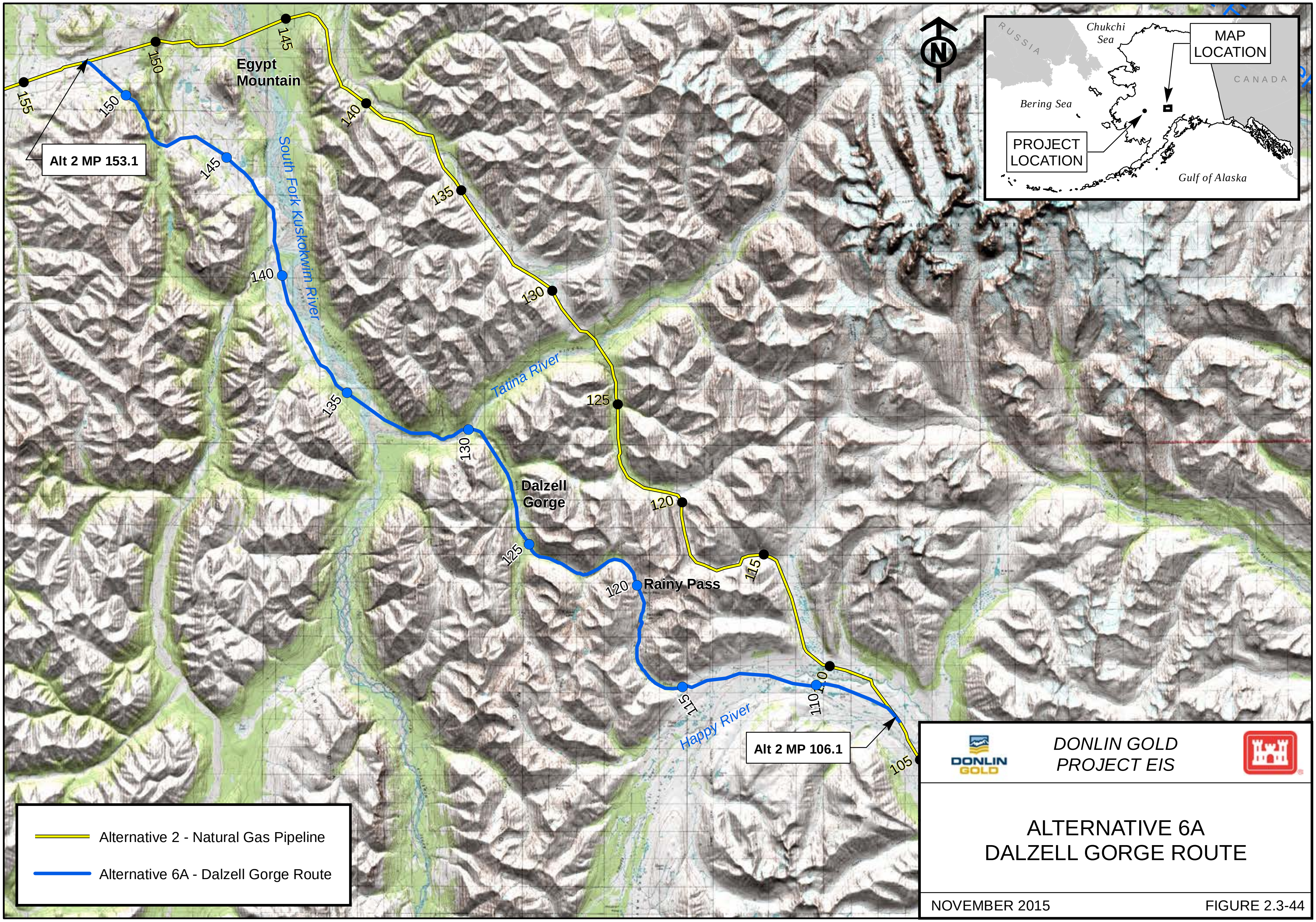
2.3.7.2 ALTERNATIVE 6A – TRANSPORTATION FACILITIES

The transportation facilities under Alternative 6A would be identical to Alternative 2.

2.3.7.3 ALTERNATIVE 6A – NATURAL GAS PIPELINE

The Alternative 6A Dalzell Gorge Route would depart to the northwest from the Alternative 2 alignment at approximately MP 106.5 (Figure 2.3-44). The route would trend west and parallel Happy River for approximately 5 miles before turning to the northwest at Pass Creek and then through Rainy Pass and Dalzell Gorge, where the terrain is steep. The route through Rainy Pass starts at an elevation of 2,500 feet and gradually climbs to an elevation of 3,327 feet over a distance of about 6 miles. North of Dalzell Gorge, the route drops to 1,500 feet elevation and would cross the Tatina River and traverse the floodplain of the South Fork of the Kuskokwim River for nearly 2 miles before crossing and proceeding parallel to the west bank in hilly terrain with some moderate side slopes at an elevation of about 1,300 feet. It would cross the Denali Fault trace and pass to the south of Egypt Mountain before rejoining the Alternative 2 route at approximately MP 152.7.

The Dalzell Gorge Route would have two mainline valves at approximately MP 119 and 138. Access roads associated with the Dalzell Gorge Route are presented in Table 2.3-39.



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ALTERNATIVE 6A
DALZELL GORGE ROUTE

NOVEMBER 2015

FIGURE 2.3-44

Table 2.3-39: Dalzell Gorge Route Access Road Identification

Milepost (approximate)	Length (miles)	Width (feet)	Description
109	0.53	24	Pass Creek Camp & Strip access
129.8	0.03	24	Tatina Camp access
130.1	0.28	24	Tatina Camp to Tatina River
133.7	0.15	24	Rohn Camp & Strip access
149.2	0.12	24	Shoofly
155.9	2.97	24	Upgrade existing trail to Farewell Strip
156	0.02	24	Farewell Camp access

Source: SRK 2012i.

Potential material sites are shown in Table 2.3-40. New gravel airstrips would be constructed at Pass Creek and Tatina.

Table 2.3-40: Potential Material Sites

Material Site	Mile Post	Area (acres)	Material Type	Designation
MS-17	108.5	22.2	Bedrock (ridge)	Airfield quarry
MS-18	114.5	9.4	Gravel (alluvial)	
MS-19	1184.0	2.5	Gravel (alluvial)	Top Pass
MS-20	123.6	28.9	Gravel (alluvial)	Dalzell Creek (camp/laydown airstrip)
MS-21A	128.1	6.5	Gravel (alluvial)	Tatina River
MS-21B	128.4	4.7	Gravel (alluvial)	Tatina River
MS-22	131.7	11.5	Gravel (alluvial)	Tatina River
MS-23	138.9	14.3	Gravel (alluvial)	Post River
MS-24	141.9	11.3	Gravel (alluvial)	South Fork tributary
MS-25	148.5	14.8	Gravel (alluvial)	
MS-26	150.5	3.3	Gravel (alluvial)	(fault zone)

Notes:
MS = material site
Source: SRK 2013b.

Table 2.3-41 presents the planned MP section and construction seasons for the Dalzell Gorge Route.

Table 2.3-41: Pipeline Construction Execution Sequence

Season	From Milepost	To Milepost	Length (Miles)	End-of-season
Winter Year 1	101.8	114.8	13	April
Summer 1.5	114.8	129.8	15	September
Summer 1.5	129.8	134.8	5	September
Winter Year 2	134.8	189.2	54	April

Source: SRK 2013b

The Dalzell Gorge Route would cross Happy River and the South Fork of the Kuskokwim River using HDD. HDD might also be used to cross an area of slope instability in Dalzell Gorge, although the required length of the drill does not make this a foregone conclusion.

Table 2.3-42 shows the potential water sources for construction of the segment of pipeline in this alternative.

Table 2.3-42: Potential Water Extraction Sites for Pipeline Construction

Water Extraction Site Name	Nearest Milepost (MP)	Water Body Type
WES-039	106.0	Pond
WES-040	108.5	Pond
WES-041	109.6	River
WES-042	114.6	Creek
WES-043	118.6	Creek
WES-044	123.3	Creek
WES-045	126.0	Creek
WES-046	128.2	River
WES-047	129.4	Creek
WES-048	132,1	River
WES-049	139.2	River
WES-050	142.4	Lake
WES-051	145.8	Creek
WES-052	153.7	Creek

Notes:

MP = milepost WES = water extraction site

Source: SRK 2012i

2.3.8 IMPACT COMPARISON – ALL ALTERNATIVES

Table 2.3-43 illustrates the primary differences between the action alternatives. The table does not summarize all the components of each alternative, but instead lists the parts of the proposed action that would differ in other alternatives. If no changes are listed (cells are blank), it is the same as Alternative 2.

Table 2.3-44 illustrates the direct and indirect impacts of each alternative. Cumulative impacts are assessed in Chapter 4, Cumulative Effects.

Table 2.3-43: Comparison of Alternatives*

Impact-causing Project Component	Alternative 2 – Proposed Action	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings	Alternative 6A – Dalzell Gorge Pipeline Route
Mine Site	Diesel fuel used to power haul trucks	LNG used to power haul trucks; an LNG plant and storage tanks built at the mine site	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
	Diesel Consumption: 42.3 Mgal/year	Diesel Consumption: 13.3 Mgal /year	Diesel Consumption: 120 Mgal /year	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
	Natural gas consumption: 11.2 BSCF/ year	Natural gas consumption: 15.5 BSCF/year	No natural gas consumption	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
	On-site diesel storage: 37.5 Mgal	Reduced on-site diesel storage	On-site diesel storage: 10 Mgal; additional infrastructure and pre-positioned equipment along pipeline ROW to respond to leaks	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
	Tailings stored in combined tailings and operating pond facility contained by one dam;	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Tailings stored as a dry stack upstream of an operating pond; operating pond contained by a main dam and two upper dams and two upper dams	Same as Alternative 2
	Tailings pumped to storage area	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Tailings moved by trucks or conveyer belt to storage area	Same as Alternative 2
	Tailings storage footprint: 2,394	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Tailings storage and operating pond footprint: 2,463 acres	Same as Alternative 2
	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	More complex operationally to filter and move tailings	Same as Alternative 2
	7 fuel ocean barge round trips per season (to Dutch Harbor)	2 fuel ocean barge round trips per season (to Dutch Harbor)	12 fuel ocean barge/tanker round trips per season (to Tyonek)	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
	14 fuel barge trips from Dutch Harbor to Bethel	5 fuel barge trips from Dutch Harbor to Bethel	No fuel barging on Bering Sea or Kuskokwim River during operations	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
Transportation Facilities	58 fuel river barge round trips per year	19 fuel river barge round trips per year	No fuel river barging during operations	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
	64 cargo barge round trips per year	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	71 cargo barge round trips per year	Same as Alternative 2
	Distance from Bethel to Angyaruaq (Jungjuk) Port: 199 miles	Same as Alternative 2	Same as Alternative 2	Distance from Bethel to BTC: 124 miles	Same as Alternative 2	Same as Alternative 2
	Length of mine access road: 30 miles	Same as Alternative 2	Same as Alternative 2	Length of mine access road: 76 miles	Same as Alternative 2	Same as Alternative 2
	Port size: 21 acres	Same as Alternative 2	Same as Alternative 2	Port size: 65 acres	Same as Alternative 2	Same as Alternative 2
	Number of material sites along mine access road: 13	Same as Alternative 2	Same as Alternative 2	Number of material sites along mine access road: 50	Same as Alternative 2	Same as Alternative 2
	Water body crossings along mine access road: 55 (6 bridges, 49 culverts)	Same as Alternative 2	Same as Alternative 2	Water body crossings along mine access road: 40 (8 bridges, 32 culverts)	Same as Alternative 2	Same as Alternative 2
	Same as Alternative 2	Same as Alternative 2	Improved dock and new diesel storage facility at the existing Tyonek North Foreland Barge Facility	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Installation of a temporary ice road from the vicinity of the Village of Crooked Creek to the mine site to construct mine access road	Same as Alternative 2	Same as Alternative 2

Table 2.3-43: Comparison of Alternatives*

Impact-causing Project Component	Alternative 2 – Proposed Action	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings	Alternative 6A – Dalzell Gorge Pipeline Route
Transportation Facilities (cont'd)	Pipeline would transport natural gas	Same as Alternative 2	Pipeline would transport diesel	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
	Diameter of pipeline: 14 inches	Same as Alternative 2	Diameter of pipeline: 18 inches	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
Pipeline	Length of pipeline: 315 miles	Same as Alternative 2	Length of pipeline: 334 miles (additional 19-mile segment between Tyonek and the start of the proposed corridor for Alt. 2)	Same as Alternative 2	Same as Alternative 2	Length of pipeline: 313 miles
	MP 106.5 to MP152.7 through Jones River Valley	Same as Alternative 2	Same alignment as Alternative 2	Same as Alternative 2	Same as Alternative 2	MP 106.5 to MP152.7 through Dalzell Gorge
	Same as Alternative 2	Same as Alternative 2	HDD crossing over Beluga River	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
	Same as Alternative 2	Same as Alternative 2	More robust leak detection system	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
	Same as Alternative 2	Same as Alternative 2	Pre-positioned response infrastructure and equipment along the pipeline route	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
	Same as Alternative 2	Same as Alternative 2	Construction of a new Operations Center and Pumping Facility in the uplands near the dock at Tyonek	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
	Same as Alternative 2	Same as Alternative 2	Some construction infrastructure remains through operations spill response capability	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
	Same as Alternative 2	Same as Alternative 2	Portions of gravel road developed during construction left in place for movement along the pipeline	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
	Airstrips: 9 new and 3 existing airstrips used during construction. New airstrips decommissioned after construction	Same as Alternative 2	Airstrips: 9 new and 3 existing airstrips used during construction. New airstrips maintained and 2 more added after construction for spill response	Same as Alternative 2	Same as Alternative 2	Airstrips: 6 new and 4 existing airstrips used during construction. New airstrips decommissioned after construction
	Same as Alternative 2	Same as Alternative 2	Portions of gravel road developed during construction left in place for movement along the pipeline	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2

Table 2.3-44: Summary of Impacts

Project Component	Alternative 2 - Donlin Gold's Proposed Action	Alternative 3A - LNG-Powered Haul Trucks	Alternative 3B - Diesel Pipeline	Alternative 4 - BTC Port	Alternative 5A - Dry Stack Tailings	Alternative 6A - Dalzell Gorge Route
Section 3.1: Geology						
Mine Site	Bedrock geology impacts would include minor grading during closure (low intensity) to ground disturbances and reshaping of landforms by blasting, excavation and fill (high intensity). There would be permanent alteration of about 505 metric tons (Mt) of ore and 2765 Mt of waste rock from the 1462 acre pit, and final elevation changes of about 600 feet. All effects would be local, limited to the mine footprint. Most bedrock is common, but the ore is unique in that it is an economic resource driving the purpose and need of the project. Disturbance of surficial geology would occur across most areas of the mine site footprint; activities would result in the permanent change to roughly 40 Mt of overburden covering about 9,000 acres. For paleontological resources, there would be a permanent alteration of a total of about 2,765 Mt of potentially fossil-bearing rock (waste rock) covering about 1,462 acres in the pit area, and permanent burial of potential fossil-bearing rock in other areas of the site covering about 6,000 acres. Potential beneficial effects from exposure of new fossils in pit wall outcrops would be dependent on adoption of additional mitigation measures. **Summary impacts would be minor to moderate.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	There would be minor differences in the amount of bedrock and rock aggregate resources disturbed and distributed**. Summary impacts would be minor to moderate.**	Same as Alternative 2.
Transportation Facilities	Bedrock geology impacts would include minor excavating or reshaping of landforms along construction areas (low intensity) to blasting, permanent reduction of material resources, and landform scars due to construction (high intensity). Impacts would primarily affect areas along the mine access road with shallow bedrock (less than 2 meters below the surface) which applies to about 16 miles of road, an additional 400 acres at other facilities (airstrip, camp, material sites) and reduction of about 2.8 million cubic yards (cy) of bedrock aggregate resources. Impacts would be local, and common in context. For surficial geology, impacts would involve ground disturbance and landform alterations across a total of about 700 acres and reduction of about 1.5 million cy of gravel resources. **Summary impacts would be minor to moderate.**	Same as Alternative 2, aside from a reduction in utilization of surficial deposits at the Dutch Harbor and Bethel ports. There would be reduced potential impacts on Quaternary fossils along the Kuskokwim River bank. Activities at relay points along the river would be rare under this alternative, as reduction of barge traffic by about one-third would nearly eliminate the need for barge travel during low water conditions. **Summary impacts would be minor to moderate.**	Same as Alternative 2, except that there would be no indirect effects on bedrock from expansion of the Dutch Harbor fuel storage facility. The additional 43 miles of the BTC Road would require roughly 35 percent more cut and fill along slide slopes with cuts into overburden. Potential effects on Quaternary vertebrate fossils along the Kuskokwim River corridor would be reduced. **Summary impacts would be minor to moderate.**	As the types of construction activities would be the same under Alternative 4 as for Alternative 2, the range of intensity of effects on bedrock resources would be the same, although more blasting would be required under Alternative 4. Potential effects on pre-Quaternary paleontological resources would be higher. **Summary impacts would be minor to moderate.**	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-44: Summary of Impacts

Project Component	Alternative 2 - Donlin Gold's Proposed Action	Alternative 3A - LNG-Powered Haul Trucks	Alternative 3B - Diesel Pipeline	Alternative 4 - BTC Port	Alternative 5A - Dry Stack Tailings	Alternative 6A - Dalzell Gorge Route
Pipeline	Impacts would primarily occur in the western portion of the route where most shallow bedrock exists, and potentially affect about 70 miles of ROW and associated infrastructure (camps, storage yards, airstrip); bedrock material sites covering a total of 500 acres; and a total reduction of about 2.8 million cy of bedrock aggregate resources. Impacts would range from low intensity where only minor excavating or reshaping of the landforms occur, to high intensity where blasting, permanent reduction in material resources, or landform scars such as at borrow pits occur. For surficial geology, potential direct impacts would range from low intensity where only minor grading occurs (e.g., at camps and storage yards), to medium intensity where ROW, road, and airstrip cuts and fills are noticeable, and high intensity at gravel pits where landform scars are obvious and large scale resource reduction occurs. These effects would range from temporary (extending through the construction phase only) to permanent (for some landform alterations), cover local extents (effects within the Project Area), and affect resources considered common to important in context. Gravel resources are widely available in the glaciated deposits of Cook Inlet basin, Skwentna Valley, and braided rivers draining the Alaska Range, and less so in the Kuskokwim Hills. However, there is little demand for gravel resources outside of Cook Inlet basin. **Summary impacts would be minor to moderate.**	Same as Alternative 2.	Same as Alternative 2, except some increased impacts would occur at off-ROW diesel pipeline facilities located in shallow bedrock areas. The increase in shallow bedrock cuts at one new airstrip, and increase in cuts in surficial deposits at 5 pipeline material sites, could potentially cause a slight increase in the probability of encountering either dinosaur track fossils in Kuskokwim Group rocks or Pleistocene vertebrates in surficial deposits. **Summary impacts would be minor to moderate.**	Same as Alternative 2.	Same as Alternative 2.	One material site (Airfield Quarry) located near MP 108.5 would utilize sedimentary bedrock and impact an area approximately 22 acres in size. **Summary impacts would be minor to moderate.**
Section 3.2: Soils						
Mine Site	Soil disturbance impacts would be medium to high (construction and operations) (compaction to complete removal), medium (closure); permanent in duration, local in extent, and common in context. Permafrost impacts would be low to medium in intensity (TSF, water dams, stockpiles, plants), low probability of medium to high (WRF); long-term to permanent in duration; local in extent; and common in context. Erosion impacts would be low to medium (construction, operations, closure, with BMPs and ESCs measures in design), low (post-closure after stabilization); temporary to long-term in duration; local in extent; and common to important in context. Soil quality impacts (fugitive dust deposition) would be low in intensity, permanent in duration, local to regional (10 miles) in extent, and common in context. **Summary impacts would be minor to moderate (with a low probability of specific major permafrost impacts).**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Slightly greater soil disturbance/removal for TSF and filter plant. Higher erosion of the dry stack surface area. Increase in fugitive dust. Summary impacts would be the same as Alternative 2.	Same as Alternative 2.
Transportation Facilities	Soil disturbance impacts would be low to high (construction and operations) (minor compaction to complete removal), low to medium (closure); permanent in duration, local in extent, and common in context. Permafrost impacts would be low to medium in intensity (all facilities), long-term to permanent in duration; local in extent; and common in context. Erosion impacts would be low to medium (construction, operations, closure, with BMPs and ESCs measures in design), low (post-closure after stabilization) or medium to high (off-road vehicle [ORV] access indirect effect); temporary to long-term in duration, or long-term to permanent (ORV access); local in extent, or local to regional (ORV access); and common to important in context. Soil quality impacts (contaminated sites) would be low to medium, or low (fugitive dust deposition); temporary to long-term (soil contamination) or permanent (fugitive dust deposition, mine access road) in duration; local in extent, and common in context. **Summary impacts would be minor to moderate.**	There would be a small reduction in impacts to Kuskokwim River bank soils at relay points; port soil/permafrost impact reduction; fugitive dust reduction along mine access road. **Summary impacts would be minor to moderate.**	Same as Alternative 2.	Soil removal and permafrost disturbance would increase at BTC Port and along mine access road. Additional minor compaction along the temporary ice roads during construction. Less riverbank disturbance would occur at Kuskokwim relay points. **Summary impacts would be minor to moderate.**	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-44: Summary of Impacts

Project Component	Alternative 2 - Donlin Gold's Proposed Action	Alternative 3A - LNG-Powered Haul Trucks	Alternative 3B - Diesel Pipeline	Alternative 4 - BTC Port	Alternative 5A - Dry Stack Tailings	Alternative 6A - Dalzell Gorge Route
Pipeline	Soil disturbance impacts would be low to high (construction) (compaction to complete removal), or low to medium (operations and closure) in intensity; permanent in duration, local in extent, and common in context. Permafrost impacts would be low to medium in intensity (BMPs applied), or low to high (post-closure); long-term to permanent in duration; local in extent; and common (to important, post-closure) in context. Erosion impacts would be low to medium with incidences of high intensity (construction and post-closure, BMPs applied), low (operations and closure) or medium to high (ORV access indirect effects); temporary (construction through closure) to long-term or permanent (ORV access) in duration; local to regional (ORV access) in extent; and common to important in context. Soil quality impacts contaminated sites would be low to medium in intensity, temporary in duration, local in extent, and common to important in context. **Summary impacts would be minor to moderate.**	Same as Alternative 2.	Additional soil disturbance with increased ROW length. **Summary impacts would be minor to moderate.**	Same as Alternative 2.	Same as Alternative 2.	Higher soil disturbance due to greater area of off ROW-disturbance. **Summary impacts would be minor to moderate.**
Section 3.3: Geohazards and Seismic Conditions						
Mine Site	Earthquake impacts would be low to medium in intensity (TSF dam, water dams, stockpiles, plants, tanks, pit operations) to high (low probability, WRF – lower lifts deform with deep ice-rich soils, and pit closure – wall failure); temporary to permanent in duration, local in extent, and common to important in context. Slope stability would be low to medium in intensity (TSF dam, WRF, FWDs, stockpiles, plants, tanks, pit operations) to high (low probability, lower CWD – landslide activation, and pit closure – pit crest settlement and overtopping); long-term to permanent in duration, local in extent, and common to important in context. Other geohazards (dam seepage) impacts would be medium in intensity (TSF dam, water dams), long-term to permanent in duration, local in extent, and common to important in context. **Summary impacts would be minor to moderate (with a low probability of specific major impacts).**	There would be more medium intensity impacts for the LNG plant, which is designed to withstand ground shaking. Summary impacts would be Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Slightly increased intensity impacts to DST by greater height in operations; slightly less in closure (shorter time to stable landform). Summary impacts would be same as Alternative 2.	Same as Alternative 2.
Transportation Facilities	Earthquake impacts would be low to medium in intensity (roads, bridges, docks, tailings), temporary to long-term in duration, local in extent, and common to important in context. Slope stability would be low to medium in intensity (roads, bridges, docks, tanks), temporary to permanent in duration, local in extent, and common to important in context. Other geohazards (tsunamis, volcanoes) impacts would be low to medium in intensity (roads, bridges, docks, tanks), temporary to long-term in duration, local in extent, and common in context. **Summary impacts would be minor to moderate.**	There would be slightly fewer low to medium intensity impacts through reduction in port fuel tanks. **Summary impacts would be minor to moderate.**	Same as Alternative 2.	Longer road increases number of seismic design bridges and material sites with slide potential. **Summary impacts would be minor to moderate.**	Same as Alternative 2.	Same as Alternative 2.
Pipeline	Earthquake and slope stability impacts would be low to medium in intensity (pipeline, associated facilities), temporary to long-term in duration, local in extent, and common to important in context. Other geohazards (HDD frac-out, tsunamis, volcanoes) impacts would be low to medium in intensity (pipeline, ROW, roads, airstrips, pads) or high (HDD river crossings, with frac-out impacts to river water quality); temporary in duration, local to regional in extent, and common to important in context. **Summary impacts would be minor to moderate (with low probability of specific major impacts from frac-out).**	Same as Alternative 2.	Seismic impact risk is slightly higher due to tank farm number increase and pipeline length. Summary impacts would be same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	More medium intensity impacts from doubled length of high-risk unstable slopes through the AK Range portion of the pipeline route. Summary impacts would be same as Alternative 2.

Table 2.3-44: Summary of Impacts

Project Component	Alternative 2 - Donlin Gold's Proposed Action	Alternative 3A - LNG-Powered Haul Trucks	Alternative 3B - Diesel Pipeline	Alternative 4 - BTC Port	Alternative 5A - Dry Stack Tailings	Alternative 6A - Dalzell Gorge Route
Section 3.4: Climate and Meteorology						
Mine Site	Any climate or meteorological impacts that would be attributable to the project would be due to air pollutants emitted during project operations and to the project's small contribution to global greenhouse gas (GHG) emissions. **See Section 3.26, Climate Change, for GHG effects.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Transportation Facilities	Same as Mine Site.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Pipeline	Same as Mine Site.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Section 3.5: Surface Water Hydrology						
Mine Site	Impact intensity would be low (runoff changes) to low to high (Snow Gulch; Crooked Creek flow reductions, depending on creek section, bedrock conditions, and precipitation) to high (American and Anaconda Creeks); long-term (Snow Gulch Reservoir, runoff changes, Crooked Creek) to permanent (American and Anaconda Creeks) in duration; local to regional in extent; and common to important in context. **Summary impacts would be minor to major (during construction and operations) and minor (after closure).**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	There would be reduced discharge to Crevice Creek and Anaconda Creek during the post-closure period, and increased treated water discharge to Crooked Creek. Summary impacts would be same as Alternative 2.	Same as Alternative 2.
Transportation Facilities	Impact intensity would be low (roads, bridges, airstrip, main camp, Angyaruaq [Jungjuk], Bethel, and Dutch Harbor Ports) to low to medium (Kuskokwim River [barging]); long term to permanent or temporary to permanent (Kuskokwim River) in duration; local to regional in extent; and common to important in context. **Summary impacts would be minor.**	There would be fewer fuel trucks on mine access road, and reduced barge-related impacts. **Summary impacts would be minor.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Pipeline	Surface water crossings (open cut, temporary, HDD) impact intensity would be low for water bodies crossed during winter months and low stream crossings, low to medium for potential scour effects; duration would be temporary to permanent, local in duration, and common to important in context. Water use impact intensity would be low (assuming winter availability data collection in final design, and volume withdrawn monitored to meet permit requirements); duration would be temporary, local to regional in extent, and common to important in context. Pipeline access and service roads, and ice roads and ice pads impact intensity would be low, temporary in duration, local in extent, and common to important in context. Gravel pads impact intensity would be low, temporary to long-term (airstrips) in duration, local in extent, and common in context. Material sites impact intensity would be low, temporary to long-term in duration, local in extent, and common to important in context. **Summary impacts would be minor.**	Same as Alternative 2.	There would be a 334-mile long diesel pipeline, 6 additional stream/river crossings, and minor water use increase for pressure testing ice roads/pads during construction. **Summary impacts would be minor.**	Same as Alternative 2.	Same as Alternative 2.	There would be a 314.2-mile long natural gas pipeline, and 377 stream crossings. **Summary impacts would be minor.**
Section 3.6: Groundwater						
Mine Site	Change in water table impact intensity would be low to high (construction, operations) or low to medium (closure), long-term (construction, operations) to permanent (closure), local in extent, and common to important in context. Change in groundwater use impact intensity would be low, long-term in duration, local in extent, and common to important in context. **Summary impacts would be minor to moderate.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Pumping water from the SRS may be required for 200 years for unlined option, 10 to 50 years for lined option. **Summary impacts would be minor to moderate.**	Same as Alternative 2.
Transportation Facilities	Change in water use impacts would be low in intensity, long-term in duration, local in extent, and common to important in context. **Summary impacts would be minor.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-44: Summary of Impacts

Project Component	Alternative 2 - Donlin Gold's Proposed Action	Alternative 3A - LNG-Powered Haul Trucks	Alternative 3B - Diesel Pipeline	Alternative 4 - BTC Port	Alternative 5A - Dry Stack Tailings	Alternative 6A - Dalzell Gorge Route
Pipeline	Same as Transportation Facilities.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Section 3.7: Water Quality						
Mine Site	Surface water quality impacts intensity would be low to high, temporary to long-term in duration, local to regional in extent, and common to important in context. Groundwater quality impact intensity would be low (outside the cone of depression) to high (locations within the mine site, long-term to permanent in duration, local in extent, and common to important in context. Sediment quality impacts would be low in intensity, temporary to long-term in duration, local in extent, and common to important in context. **Summary impacts would be minor to moderate.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Treating water from the SRS may be required for 200 years for unlined option, 10 to 50 years for lined option. Lined option would minimize (but not prevent) impacts to groundwater quality. Higher risk of SRS pump failure for unlined option. Pit lake stratification would occur at an approximately 40 percent shallower depth, and metals in pit surface water would likely be higher. Increase in dry stack fugitive dust atmospheric deposition would lower sedimentation quality (BMPs applied). **Summary impacts would be moderate to major.**	Same as Alternative 2.
Transportation Facilities	Surface water quality impacts intensity would be low, temporary to long-term in duration, local in extent, and common to important in context. Groundwater and sediment quality impact intensity would be low, temporary in duration, local in extent, and common to important in context. **Summary impacts would be minor.**	Same as Alternative 2.	Same as Alternative 2.	There would be a lower impact from propeller wash. **Summary impacts would be minor.**	Same as Alternative 2.	Same as Alternative 2.
Pipeline	Surface water quality impacts intensity would be low, temporary to long-term in duration, local in extent, and common to important in context. Groundwater and sediment quality impact intensity would be low, temporary in duration, local in extent, and common to important in context. **Summary impacts would be minor.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Section 3.8: Air Quality						
Mine Site	Air quality impacts would be low in intensity, temporary to long-term in duration, local in extent, and common in context. **Summary impacts would be minor.**	There would be lower impacts from less diesel used, and a slight increase in impacts from more LNG used. **Summary impacts would be minor.**	Emissions of mercury, NO_x, CO, PM, SOx, and GHGs would increase, and emissions of VOCs would decrease, but still be within permitting and regulatory thresholds. **Summary impacts would be minor.**	Same as Alternative 2.	Mobile emissions would increase, and exposure of dry stack surface would increase fugitive emissions, but would be offset by elimination of fugitive dust from TSF beach area. **Summary impacts would be minor.**	Same as Alternative 2.
Transportation Facilities	Air quality impacts would be low in intensity, temporary to long-term in duration, local to regional in extent, and common in context. **Summary impacts would be minor.**	Using LNG haul trucks during operations would result in lower emissions of all pollutants. **Summary impacts would be minor.**	Same as Alternative 2.	Criteria air pollutants and GHG emissions are expected to increase about 3 times. Increase in emissions due to the longer road would be largely offset by the reduced barging emissions. Permitting and regulatory thresholds would still be met. **Summary impacts would be minor.**	During operations there would be a 6% increase in cargo barge traffic compared to Alternative 2. Permitting and regulatory thresholds would still be met. **Summary impacts would be minor.**	Same as Alternative 2.

Table 2.3-44: Summary of Impacts

Project Component	Alternative 2 - Donlin Gold's Proposed Action	Alternative 3A - LNG-Powered Haul Trucks	Alternative 3B - Diesel Pipeline	Alternative 4 - BTC Port	Alternative 5A - Dry Stack Tailings	Alternative 6A - Dalzell Gorge Route
Pipeline	Same as Transportation Facilities.	Same as Alternative 2.	Fugitive GHG emissions from the diesel pipeline would be less compared to that of natural gas pipeline. **Summary impacts would be minor.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Section 3.9: Noise and Vibration						
Mine Site	Project-related noise at receptor (A-weighted decibel, day-night sound level [dBA L_{DN}]) impacts intensity would be low, temporary to long-term in duration, local in extent, and common in context. **Summary impacts would be minor.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Transportation Facilities	Same as Mine Site.	Same as Alternative 2.	Same as Alternative 2.	There would be additional heavy equipment operations during construction of longer BTC Road. **Summary impacts would be minor.**	Same as Alternative 2.	Same as Alternative 2.
Pipeline	Project-related noise at receptor (dBA L_{DN}) impacts intensity would be low to high, temporary to long-term in duration, local in extent, and common in context. **Summary impacts would be minor.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Section 3.10: Vegetation						
Mine Site	Direct impacts include removal of 8,954.6 acres of vegetation within the footprint of mine facilities. One unconfirmed population of a rare plant that has no special protection status occurs and would be removed in the TSF footprint; mitigation could include reseeding or replanting where possible. Indirect impacts include increased risk of accidental damage, invasive species introduction and spread, fugitive dust, and changes in water availability. While the vegetation disturbance in the construction areas outside the footprint would be temporary to permanent, the vegetation in the Project Area would be altered for the duration of the project (long-term) or permanently. After mine closure the area would be reclaimed including re-contouring roadways and planting native vegetation and reseeding disturbed areas with native seeds. While these areas are expected to revegetate, they are not likely to have the same plant composition or structure as they did prior to disturbance. The area occupied by the pit lake would not revegetate, and would have permanent vegetation loss. Extended impacts are possible if invasive species spread beyond known locations or become established in new areas. Impacts to vegetation would be to common vegetation type communities aside from the possible rare plant species, **Summary impacts would be moderate.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Direct impacts include removal of 9,401.4 acres of vegetation, an increase of 446 acres compared to Alternative 2 within the footprint of mine facilities at the TSF site. Fugitive dust impacts may increase. **Summary impacts would be moderate.**	Same as Alternative 2.

Table 2.3-44: Summary of Impacts

Project Component	Alternative 2 - Donlin Gold's Proposed Action	Alternative 3A - LNG-Powered Haul Trucks	Alternative 3B - Diesel Pipeline	Alternative 4 - BTC Port	Alternative 5A - Dry Stack Tailings	Alternative 6A - Dalzell Gorge Route
Transportation Facilities	Direct impacts include removal of 872.4 acres of vegetation and reclamation at the airstrip, mine access road, Bethel Port expansion area, and Angyuruaq (Jungjuk) Port. Indirect impacts include increased risk of accidental damage, invasive species introduction and spread, fugitive dust, and changes in water availability. Fugitive dust could cause physiological changes to vegetation pending exposure length or level. Ocean barge trips are expected to be 20 trips per year during construction and 26 trips per year during operations. **Summary impacts would be moderate.**	Fugitive dust and invasive species introduction and spread risk may be reduced due to 65% fewer ocean barge trips during operations (17 trips/year during operations) and 68% fewer river trips (83 trips per year), and fewer trucks hauling diesel on the Jungjuk road (about half as many during operations compared to construction). **Summary impacts would be moderate.**	Total barge traffic on the Kuskokwim River would be approximately halved (64 trips/year), reducing invasive species introduction and spread risk. Ocean barge trips would be reduced to 12 trips per year, further reducing risk. **Summary impacts would be moderate.**	Direct impacts to vegetation include removal (approximately 1,605 acres, an increase of 733 acres compared to Alternative 2) and reclamation along a longer mine access road and in the BTC port area. Invasive species introduction and risk would remain the same with increased road length but decreased barge traffic from the BTC port site upriver. **Summary impacts would be moderate.**	Same as Alternative 2.	Same as Alternative 2.
Pipeline	Direct impacts would include 5,963.8 acres of vegetation removal, reclamation, and periodic maintenance (brushing). Potential removal of rare plants is also possible although the two known rare species populations are outside the construction area. Indirect impacts would include invasive species introduction and spread. A much larger area would be affected temporarily during construction than long-term during operations. Access roads for construction would be reclaimed shortly after construction, so impacts would be short-term. After pipeline burial, most of the disturbed area would be revegetated with native seeds, fertilizer, and mulch as required. Changes in vegetation community type composition may be permanent in areas were soil conditions are altered. Only a small proportion of each vegetation community type would be impacted within the greater watershed, and only common types would be impacted. **Summary impacts would be moderate.**	Same as Alternative 2.	Direct impacts would include 6,214.5 acres of vegetation removal, reclamation, and periodic maintenance (brushing), an additional 250.7 acres compared to Alternative 2. Invasive species introduction and spread risk is therefore slightly higher due to increased known presence of invasive plant species near the Tyonek dock. **Summary impacts would be moderate.**	Same as Alternative 2.	Same as Alternative 2.	Direct impacts would include 5,876.5 acres of vegetation removal, 87.5 fewer acres than Alternative 2, along the alternative alignment corridor. **Summary impacts would be moderate.**
Section 3:11: Wetlands						
Mine Site	Direct wetland impacts would affect 5% to more than 25% by acreage of highly- or moderately- functioning wetlands in the American Creek and Anaconda Creek watersheds. Wetland functions would be eliminated and would not be anticipated to return to previous functions after the action that caused the impacts ceased; or within several decades after restoration. Impacts would occur to wetlands that are widespread and typical of the region as well as those that support important local or regional subsistence resources. A total of 6,966 acres would be affected directly including 6,641 from cut and fill and 325 from vegetation clearing. **Summary impacts would be moderate.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Similar to Alternative 2. Wetland acres impacted by tailings storage under Option 1 would be 2,359 acres (140 acres less than Alternative 2 at 2,499 acres); under Option 2 would be 2,593 acres (94 acres more than Alternative 2). **Summary impacts would be moderate.**	Same as Alternative 2.

Table 2.3-44: Summary of Impacts

Project Component	Alternative 2 - Donlin Gold's Proposed Action	Alternative 3A - LNG-Powered Haul Trucks	Alternative 3B - Diesel Pipeline	Alternative 4 - BTC Port	Alternative 5A - Dry Stack Tailings	Alternative 6A - Dalzell Gorge Route
Transportation Facilities	Direct wetland impacts would be a 1% reduction in wetland abundance from construction and operations, and potential indirect impacts to 7-14% of high functioning wetlands. There may be potential increases in wetland erosion rates resulting from barge wake energy, with an increase of 2-8% of river tractive energy along Kuskokwim River shorelines; impacts would be low or medium. Wetlands would be affected in the vicinity of the mine access road, port, and airstrip within the Crooked Creek watershed. The impacts would be permanent for the road and airstrip but temporary for reclaimed areas. Barge impacts would occur during operations. Common wetland vegetation types would be affected on land. Shoreline wetlands may be important in supporting anadromous fish streams and subsistence resources. **Summary impacts would be moderate.**	Fewer barge trips (122 reduced to 83 round trips) would reduce potential barge-related river wetland erosion rates. There would be fewer truck trips between the port and mine site, which may lessen dust and gravel spray impacts to wetlands. **Summary impacts would be moderate.**	Barge traffic-induced river wetland erosion rates would be reduced by elimination of fuel barging after construction. Cargo barging would remain the same as Alternative 2. Estimated barge traffic would be reduced from 122 to 64 round trips. **Summary impacts would be moderate.**	Construction of the BTC road, BTC port, mine airstrip and mine access road would directly impact 1,120 additional acres of wetlands. Some impacts would be permanent as the road and airstrip would remain open. **Summary impacts would be moderate.**	Same as Alternative 2.	Same as Alternative 2.
Pipeline	Direct impacts to wetlands would be a 5% reduction in abundance (2,339.5 acres total), and potential reduction of 5-8 percent of high functioning wetlands. Construction impacts would be highest, and operations would be lower in intensity. Impacts would be short-term during construction, as reclamation would take place immediately after construction ended. Functions may be reduced for extended periods. About 21% of the pipeline ROW would cross permafrost-based wetlands, 8% of which are unstable permafrost soils which may be difficult to restore as wetlands. Impacts would be regional along small areas of wetlands in multiple watersheds. Wetland vegetation types are common. **Summary impacts would be moderate.**	Same as Alternative 2.	Construction of the diesel pipeline would impact an additional 226.5 acres of wetlands compared to Alternative 2 (2,566.0 acres total). **Summary impacts would be moderate.**	Same as Alternative 2.	Same as Alternative 2.	Direct impacts to wetlands would increase by 98 acres compared to Alternative 2. Most of the additional wetland construction would take place during winter. High functioning wetland impacts would be variable. 24% of the route crosses permafrost stable soils, and 8% crosses unstable permafrost soils. **Summary impacts would be moderate.**

Table 2.3-44: Summary of Impacts

Project Component	Alternative 2 - Donlin Gold's Proposed Action	Alternative 3A - LNG-Powered Haul Trucks	Alternative 3B - Diesel Pipeline	Alternative 4 - BTC Port	Alternative 5A - Dry Stack Tailings	Alternative 6A - Dalzell Gorge Route
Section 3.12: Wildlife						
Mine Site	*Terrestrial mammals:* impacts to habitat include removal or modification of vegetation types, habitat fragmentation, behavioral disturbance, exposure to potentially toxic materials, potential for injury and mortality, and potential for accidental fires that impact habitat. Invasive species impacts could include invasive aquatic plant species and Norway rat impacting habitat in limited locations. Indirect impacts by behavioral disturbance (from mine site blasting or noise from heavy machinery) and barriers to movement impacts would occur during construction and operations. Injury and mortality impacts would be temporary and localized to construction or transportation facility areas. Increased hunting and trapping pressure impacts may occur during operations with increased access, although these activities would not be permitted. **Summary impacts would be minor to moderate.** *Marine mammals:* **Summary impacts would be no impacts.** *Birds:* long-term habitat loss or alteration impacts would occur during construction and operations with vegetation removal. Some habitat may increase for species that prefer early successional areas and edges. Environmental contamination impacts (from tailings pond, contact water pond, and pit lake) would be permanent. Blasting and machinery operation noise may lead to birds avoiding the mine site for the duration of operations. Risk of injury or mortality from collisions impacts would occur for construction and operations. Predators attracted to organic waste impacts would occur during operations, but be mitigated through management plans. **Summary impacts would be minor to moderate.**	Fewer fuel trucks reduces collision risk for terrestrial mammals. **Summary impacts would be minor to moderate.**	Fewer fuel trucks reduces collision risk for terrestrial mammals. **Summary impacts would be minor to moderate.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Transportation Facilities	*Terrestrial mammals:* habitat modification impacts intensity would be low during construction and operations as less habitat would be impacted than in other components. Invasive species impacts to habitat may include introduction or spread of aquatic invasive plants or Norway rats on barges, but risk would be low due to mitigation through management plans. Behavioral disturbance impacts would be high during construction but lower during operations along the river and road corridors. Barriers to movement impacts may occur along roads throughout construction and operations. Injury and mortality impacts may occur during construction and through operations along road corridors primarily, and continue throughout operations. Increased hunting and trapping pressure impacts would be low due to controlled access during operations. **Summary impacts would be minor to moderate.** *Marine mammals:* Behavioral disturbance or injury or mortality impacts would be low in intensity, unlikely, and limited to potential impacts from barges. Due to the MMPA, the context of any impact would be important. **Summary impacts would be negligible to minor.** *Birds:* Habitat loss impacts would be medium as there is an abundance of habitat in surrounding areas. Blasting and noise impacts would occur during construction at material sites, and may cause avoidance behavior. Collision impacts are low to medium intensity and are expected to be in low number, causing no population level impacts. **Summary impacts would be minor to moderate.**	Same as Alternative 2 (lower disturbance to riparian mammals due to fewer barge trips; fewer fuel trucks lowers collision risk).	Same as Alternative 2 (lowest amount of disturbance to riparian mammals due to lower number of barge trips; fewer fuel trucks lowers collision risk).	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-44: Summary of Impacts

Project Component	Alternative 2 - Donlin Gold's Proposed Action	Alternative 3A - LNG-Powered Haul Trucks	Alternative 3B - Diesel Pipeline	Alternative 4 - BTC Port	Alternative 5A - Dry Stack Tailings	Alternative 6A - Dalzell Gorge Route
Pipeline	*Terrestrial mammals:* habitat modification would mainly be temporary during construction. Invasive species impacts may include invasive plant introduction from existing infrastructure impacting habitat but would be mitigated by management plans. Behavioral disturbance impacts may be high due to construction noise during construction but not during operations as the pipeline would be buried. Barriers to movement impacts and injury and mortality impacts would be low for mobile species or higher for burrow and denning species, during construction. Increased hunting and trapping pressure may occur with more use and access within the area. **Summary impacts would be minor to moderate.** *Marine mammals:* **For operations and closure, the Summary impacts would be no effect. For construction, the impacts would be the same as for Transportation Facilities.** *Birds:* Habitat loss impacts would occur during construction and through operations as vegetation was reclaimed or revegetated. Noise would continue through construction. During operations, impacts would be lower as the pipeline would be buried. **Summary impacts would be minor to moderate.**	Same as Alternative 2.	Impacts may be slighter higher for mammals with a longer pipeline route. **Summary impacts would be minor to moderate.**	Same as Alternative 2.	Same as Alternative 2.	Slightly higher potential for impacts to caribou or bison during construction. **Summary impacts would be minor to moderate.**
Section 3.13: Fish and Aquatic						
Mine Site	Permanent in-stream habitat removal and disturbance or loss of fish and benthic biota would occur on 8 miles within 5 drainages during all phases (Snow Gulch, Lewis Gulch, American Creek, Omega Gulch, Anaconda Creek). Tributaries impacted by water management practices would experience permanent loss of aquatic habitats, fish, and other aquatic species within the Crooked Creek watershed. Streamflow reductions in Crooked Creek near the MSA would be moderate (major in a High K scenario). Water quality impacts would be low. Wetland impacts to aquatic habitats would be permanent due to effects of reduced surface water runoff and reduced water quality functions within several drainages east of Crooked Creek. Context for lower reaches of Crooked Creek, American and Anaconda Creeks, the mainstem of Crooked Creek from its mouth to Donlin Creek, and Getmuna and Bell Creeks are important as they are regulated as EFH. Reduced groundwater inflows to Crooked Creek would impact stream temperature during operations. Erosion and stream sedimentation would be controlled and mitigated to reduce impacts. **Summary impacts would be moderate.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Reduced storage requirements within the TSF would lessen the risk of potential dam failure and release of slurry materials downstream to Anaconda and Crooked Creeks. **Summary impacts would be moderate.**	Same as Alternative 2.

Table 2.3-44: Summary of Impacts

Project Component	Alternative 2 - Donlin Gold's Proposed Action	Alternative 3A - LNG-Powered Haul Trucks	Alternative 3B - Diesel Pipeline	Alternative 4 - BTC Port	Alternative 5A - Dry Stack Tailings	Alternative 6A - Dalzell Gorge Route
Transportation Facilities	Bank erosion and riverbed scour along the Kuskokwim River could cause minor to moderate habitat disruption (major in shallow, narrow channels) and increased suspended sediment concentrations and turbidity, displacement or stranding of young-of-year fish along certain shallow-gradient riverbanks and bars, behavioral disturbance to resident and anadromous fish life stages (migration, rearing/feeding, and spawning, and propeller strikes or shear forces causing fish injuries or mortalities or alteration of fish behavior and migration. Impacts would occur during construction and operations at different times of the year based on fish migration and behavior patterns. Fish species impacted are common to the Kuskokwim River area but important in the context of EFH and as anadromous salmon species. Stream crossings along the mine site road may increase sedimentation or cause other impacts to streams; impacts would be mitigated by BMPs. Main tributaries impacted include upper Getmuna Creek and Crooked Creek during construction and some impacts during operations. **Summary impacts would be moderate.**	Barge trip reduction would result in a reduction in the amount of tug and barge-generated wakes, prop wash, and riverbed scour. Impacts would be similar to Alternative 2. **Summary impacts would be moderate.**	Barge trip reduction would result in a reduction in the amount of tug and barge-generated wakes, prop wash, and riverbed scour. Almost no travel would be required during low flow conditions. Impacts would be similar to Alternative 2. **Summary impacts would be moderate.**	Due to the shorter river distance traveled by barges, the intensity of impacts would be reduced for wave energy on water quality and fish displacement/stranding, for tug propeller forces on bed scouring and aquatic habitat, for construction and operations phases. Impacts from the longer mine access road would be increased risk of sedimentation from stream crossings, particularly during construction. **Summary impacts would be moderate.**	Same as Alternative 2.	Same as Alternative 2.
Pipeline	Impacts to anadromous or resident fish and aquatic habitats would occur along the pipeline ROW, low to medium intensity, with highest impacts where HDD methods are not used for stream crossings. Impacts would include stormwater runoff, suspended soils, and altered flows from disturbed soils; water withdrawals for ice-road construction, construction of pipeline used open-trench methods, and water releases from pipeline hydrotesting. Impacts would mainly occur during construction. Crossings classified as EFH would be important in context. **Summary impacts would be minor to moderate.**	Same as Alternative 2.	Increased disturbance would occur with additional construction acres from Tyonek to Beluga for the diesel pipeline. During operations, an additional 24 barge trips would arrive at the terminal annually. **Summary impacts would be minor to moderate.**	Same as Alternative 2.	Same as Alternative 2.	There would be slightly fewer (22 compared to 28) stream crossings at sites with permafrost or erodible soils and confirmed fish presence. Impacts would be similar to Alternative 2. **Summary impacts would be minor to moderate.**
Section 3.14: Threatened and Endangered Species						
Mine Site	**Summary impacts would be no impacts.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-44: Summary of Impacts

Project Component	Alternative 2 - Donlin Gold's Proposed Action	Alternative 3A - LNG-Powered Haul Trucks	Alternative 3B - Diesel Pipeline	Alternative 4 - BTC Port	Alternative 5A - Dry Stack Tailings	Alternative 6A - Dalzell Gorge Route
Transportation Facilities	*Eiders:* During construction and operations, eiders may experience during certain times of the year (when barge traffic and certain behaviors overlap) behavioral disturbance from increased barge traffic, and have risk of injury or mortality from collisions with barges. There is also risk of contamination, injury, or death from fuel or chemical spills. Large numbers of Steller's eiders use habitat within Kuskokwim Bay for spring staging and during a 3-week molt period following breeding. Spectacled eiders use habitat in the coastal area from the west side of the Kuskokwim River north and west along the coast. The most important barge timing overlap is when barges pass by part of the area where Steller's eiders molt between July and November. Context would be unique for Steller's eider and important for spectacled eider due to their ESA-listed status. Marine mammals: During construction and operations, behavioral disturbance is possible from barge traffic, or collisions with ocean barges causing death or injury. Noise from vessel traffic and port and dock construction noise may interfere with marine mammal communication or cause deflection or avoidance of the river, dock, and port areas. Injuries could include lacerations to serious injury or mortality from propeller cuts to blunt force trauma. Contamination impacts are also possible. The potential for collisions increases when vessels travel higher than speeds of 15 knots. Vessel strike around the Kuskokwim River and at the river mouth would be minimized by relatively low speed. Cargo river barges are expected to travel at 4 knots upriver and 10 knots downriver when unloaded. Fuel barges would travel at 3.5 knots upriver, and 10 knots downriver. Distribution of right whales in particular is limited in barge travel areas, further minimizing potential for collisions. **Summary impacts would be minor (eiders). Summary impacts would be negligible to minor (marine mammals), except if a right whale or Cook Inlet beluga whale is injured or killed in which case impacts would be moderate to major.**	The reduced number of barge trips reduces risk of adverse impacts to eiders. **Summary impacts would be the same as Alternative 2.**	The overall chance of adverse impacts to eiders and marine mammals would be reduced by lower barge activity, but cargo barge activity would remain the same. **Summary impacts would be the same as Alternative 2.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Pipeline	Same as Mine Site.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Section 3.15: Land Ownership, Management, and Use						
Mine Site	Change in land ownership impact intensity would be low (17(b) easements), permanent in duration, local in extent, and important in context. Change in land management would be no impact, as action is consistent with management plans. Change in land use would be low (closure) to high (construction and operations) (beneficial, with positive changes to lands from the vantage of the land owner), long-term (construction and operations) to permanent (closure) in duration, local in extent, and important in context, or unique (mineral resource rare on Calista/TKC lands impacted). **Summary impacts would be major and beneficial.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Transportation Facilities	Change in land ownership and change in land management impact intensity would be the same as the Mine Site. Change in land management impact would be high intensity (change from undisturbed and partially disturbed lands to an industrial use, and beneficial from the vantage point of private land owners such as Calista Corporation, TKC, and the Dutch Harbor and Bethel ports, during construction and operations) to low (closure), long-term (construction and operations) to permanent (closure) in duration, regional in extent, and common in context. **Summary impacts would be major (beneficial) except low (adverse) for low level uses of state lands.**	Same as Alternative 2.	Same as Alternative 2.	Impacts would be reduced from barging a shorter distance, but increased from a longer access road. Impacts would include low intensity indirect effects to land management if conveyance of selected lands along the proposed road to BTC is accelerated. **Summary impacts would be moderate to major.**	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-44: Summary of Impacts

Project Component	Alternative 2 - Donlin Gold's Proposed Action	Alternative 3A - LNG-Powered Haul Trucks	Alternative 3B - Diesel Pipeline	Alternative 4 - BTC Port	Alternative 5A - Dry Stack Tailings	Alternative 6A - Dalzell Gorge Route
Pipeline	Change in land ownership impact intensity would be no effect (direct impacts) to low (indirect impacts); no effect (direct impacts) or temporary to long-term (indirect impacts) in duration; no effect (direct impacts) to local (direct impacts) in extent; and no effect (direct impacts) to common (indirect impacts) in context. Change in land management would be the same as the Mine Site. Change in land use impact intensity would be high, long-term in duration, regional in extent (affecting resources along the pipeline ROW), and common in context, except where impacts to the Iditarod National Historic Trail (INHT) would be important. **Summary impacts would be moderate.**	Same as Alternative 2.	Same as Alternative 2,	Same as Alternative 2.	Same as Alternative 2.	The ROW would be slightly shorter, but would not change land ownership. The alternative alignment would intersect more state lands crossing or adjacent to the INHT. **Summary impacts would be moderate.**
Section 3.16: Recreation						
Mine Site	Change in recreational access impacts would be low in intensity, long-term or permanent (changes in 17(b) easements) in duration, local in extent, and common in context, except important (17(b) easement changes. Change in recreation settings and activities would be low (closure) to high (construction and operations), long-term in duration, local in extent, and common in context, except important in (17(b) easement changes. Recreation use levels are low, and would remain low. Indirect impacts could include perceived contamination of the area. **Summary impacts would be negligible.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Transportation Facilities	Change in recreational access impacts would be low in intensity (closure) to medium (construction and operations), long-term or permanent (changes in 17(b) easements) or temporary (some sections of trail may be closed during construction) in duration, regional in extent, and common in context, except important in (17(b) easement changes. Change in recreation settings and activities would be low, long-term in duration, regional in extent, and common in context. Recreation use levels are low, and would remain low. **Summary impacts would be negligible.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Pipeline	Change in recreational access impacts would be medium, long-term (brush clearing during operations) or permanent (upgrades to three airstrips) in duration, regional in extent, and common in context, except that changes in INHT would be important. Change in recreation settings and activities would be none (closure) or low (operations) or medium (construction), temporary in duration, regional in extent, and common in context, except that changes in INHT would be important. Recreation use levels are low in summer, and moderate in winter. Indirect impacts could increase use, particularly in winter. **Summary impacts would be moderate.**	Same as Alternative 2.	Impacts to recreation may increase due to infrastructure left in place for a diesel spill response. **Summary impacts would be moderate.**	Same as Alternative 2.	Same as Alternative 2.	Activities and infrastructure would affect a medium number of INHT recreationists, but over a greater area with the majority using the trail during the winter season. **Summary impacts would be moderate.**
Section 3.17: Visual						
Mine Site	Impacts intensity would be high from strong visual contrast of mining equipment, ACMA and Lewis pits, and infrastructure; permanent in duration, as sources of visual contrast would persist following closure of the mine site; local in extent, and common in context with no sensitive viewers. **Summary impacts would be moderate.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-44: Summary of Impacts

Project Component	Alternative 2 - Donlin Gold's Proposed Action	Alternative 3A - LNG-Powered Haul Trucks	Alternative 3B - Diesel Pipeline	Alternative 4 - BTC Port	Alternative 5A - Dry Stack Tailings	Alternative 6A - Dalzell Gorge Route
Transportation Facilities	Impacts intensity would be low, duration long-term (direct impacts from increased barge and port traffic), regional in extent (though affecting discrete areas along the Kuskokwim River), and important in context. **Summary impacts would be moderate.**	Intensity of impacts resulting from barge traffic would be less as the number of trips would be reduced by one-third. **Summary impacts would be moderate.**	Intensity of impacts resulting from barge traffic would be less as the number of trips would be reduced by one-half. **Summary impacts would be moderate.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Pipeline	Impacts intensity would be moderate (low to high intensity impacts due to vegetation clearing: low intensity where the ROW crosses areas characterized by low stature or variable vegetation structure; moderate to high intensity where the ROW crosses areas characterized by open or closed forests). Visual contrast of the ROW would be strongest in these areas when viewed from elevated or aerial vantage points. Extent would be local, and context would be common except important for the INHT. **Summary impacts would be moderate.**	Same as Alternative 2.	Additional direct impacts could result from construction (expansion) of the existing dock at Tyonek and operation of the expanded port facility. **Summary impacts would be moderate.**	Same as Alternative 2.	Same as Alternative 2.	The pipeline would cross, be collocated, or be located in close proximity to the INHT for a greater percentage of the corridor. **Summary impacts would be moderate.**
Section 3.18: Socioeconomics						
Mine Site	Impacts intensity would be medium to high intensity (increased levels of employment and expenditures in excess of historic limits and trends; employment effects would be particularly high within the Yukon-Kuskokwim (Y-K) region). Impact intensity of project payments to state and local governments and ANCSA corporations would be medium to high and beneficial, while the impacts intensity on public infrastructure would be low. Duration would be temporary (construction) or long-term (operation and closure) in duration. Extent would be variable but primarily regional (affecting communities throughout the Project Area). Context for direct impacts would be important given Donlin Gold's commitment to hire qualified Y-K region residents, thus affecting primarily minority and low-income populations. **Summary impacts would be moderate (beneficial) to Alaska and major (beneficial) in the Y-K region.**	Decrease in jobs and fuel cost savings would result from using LNG instead of diesel; would be small relative to total project employment and expenditures. Revenues to the City of Unalaska from its property tax would not increase because an increase in tank storage capacity at the Port of Dutch Harbor would probably not be required. **Summary impacts would be the same as Alternative 2.**	A larger workforce and increased expenditures required to construct a diesel pipeline and power mining operations with diesel would more than offset any decreases in employment and expenditures due to reduced diesel shipping, barging, trucking, and storage requirements. Construction of a new or expanded dock facility and fuel storage in Cook Inlet would enhance the beneficial effects in the Kenai Peninsula Borough. **Summary impacts would be the same as Alternative 2.**	A larger workforce required to construct a longer road and truck freight and diesel would more than offset any decreases in employment due to reduced barge crews. Construction of a longer road would increase expenditures. **Summary impacts would be the same as Alternative 2.**	Same as Alternative 2.	As a result of the larger workforce and higher expenditures required to construct a pipeline with additional HDD, there would be an enhancement of beneficial direct and indirect employment, income, and sales impacts during project construction. **Summary impacts would be the same as Alternative 2.**
Transportation Facilities	Same as for Mine Site.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Pipeline	Same as for Mine Site.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-44: Summary of Impacts

Project Component	Alternative 2 - Donlin Gold's Proposed Action	Alternative 3A - LNG-Powered Haul Trucks	Alternative 3B - Diesel Pipeline	Alternative 4 - BTC Port	Alternative 5A - Dry Stack Tailings	Alternative 6A - Dalzell Gorge Route
Section 3.19: Environmental Justice						
All Components	Changes in socioeconomic indicators, subsistence, and human health were analyzed to evaluate the potential for disproportionate adverse impacts to low-income and minority communities that may raise environmental justice concerns. The proposed project would have major beneficial socioeconomic impacts to the Y-K region. Most communities in the Y-K region are considered to have low-income and/or minority populations. There would be minor to moderate adverse impacts to subsistence, with the moderate adverse impacts occurring for subsistence fishing in the narrow reaches of the Kuskokwim River (potentially impacting low-income and minority Kuskokwim River communities) and subsistence competition near the Farewell Airstrip area (potentially impacting McGrath, Nikolai, and other low-income and minority communities harvesting subsistence resources in the vicinity). Income which may be used to purchase tools and transportation necessary for subsistence would bring moderate beneficial impacts to the low-income and minority communities of the Y-K region. There could be medium adverse human health impacts to the low-income and minority populations in the Y-K region, with potential increases in rates of accidents, injuries, and non-communicable and chronic diseases. However, there would be medium beneficial human health impacts to the low-income and minority populations of the Y-K region with increased affordability and access to healthcare and improved food security with increased income to facilitate subsistence harvests. Overall, impacts to low-income and minority communities would be both beneficial and adverse and range from low to high intensity. The extent of impacts would be regional (occurring in the Y-K region) and long-term (lasting throughout the project). The context of impacts would be considered unique (affecting minority and low-income populations). Beneficial and adverse effects to low-income and minority populations would be moderate. While socioeconomic impacts and some health impacts would be beneficial and predominantly affect minority and low income communities, **adverse impacts would be disproportionate to low-income and minority communities.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Section 3.20: Cultural Resources						
Mine Site	Medium intensity direct impact to one resource recommended as eligible for the National Register of Historic Places. Duration would be permanent in extent (resource removed from original locations if site cannot be avoided), local in extent (affecting a single resource), important in context (to the subregion). **Summary impacts would be moderate.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Transportation Facilities	A site was located in the vicinity but is not anticipated to be affected. **Summary impacts would be no effect.**	Same as Alternative 2.	Same as Alternative 2.	Medium intensity direct impact to one resource recommended as eligible for the National Register of Historic Places. Duration would be permanent in extent (resource removed from original locations if site cannot be avoided), local in extent (affecting a single resource), important in context (to the subregion). **Summary impacts would be moderate.**	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-44: Summary of Impacts

Project Component	Alternative 2 - Donlin Gold's Proposed Action	Alternative 3A - LNG-Powered Haul Trucks	Alternative 3B - Diesel Pipeline	Alternative 4 - BTC Port	Alternative 5A - Dry Stack Tailings	Alternative 6A - Dalzell Gorge Route
Pipeline	Medium intensity direct impacts to five resources recommended as eligible for the National Register of Historic Places. Duration would be permanent (resources removed from original locations if sites cannot be avoided), extent would be local (affecting a single resources), context would be important in context (to the subregion). **Summary impacts would be moderate.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Section 3.21: Subsistence						
Mine Site	At the mine site, negligible intensity impacts for all communities except low intensity effects on resources used by Crooked Creek residents subsistence practices; low impact after closure. Low to moderate impacts from barging activity. Long-term duration during mine life; local extent except perceived regional effect on waterfowl, competition effects, and socio-cultural impacts. Competition impacts would affect scarce resources that are important in context. Socio-cultural impacts would affect subsistence use practices of rural communities that are unique in context (protected by federal law and rare in the U.S.) **The summary impacts would be minor to moderate, except for moderate beneficial employment and income effects**.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Transportation Facilities	Intensity would be generally low, except for medium effects from barging in narrow, shallow segments, and medium intensity impacts in displacement of access for fish camps near Angyaruaq (Jungjuk) Port. Effects would be long-term in duration, and regional in extent, extending along the river transportation corridor. Resources affected would be important in context in regard to Chinook salmon, fish camps near Angyaruaq, and in-region competition. Context would be unique in the case of socio-cultural impacts to subsistence communities. Summary impact would be minor, except moderate for subsistence fishing in narrow reaches of the Kuskokwim River. **Summary impacts would be minor, except moderate for subsistence fishing in narrow reaches of the Kuskokwim River.**	Barge frequency would be reduced by 32% due to reduction in diesel fuel barging, reducing impacts to fishing in narrow reaches of the river to low intensity. **Summary impacts would be minor.**	Barge frequency would be reduced by 47.5% with elimination of diesel fuel barging, reducing impacts to fishing in narrow reaches of the river to low intensity. Expanded dock near Tyonek receiving diesel tankers would be low intensity impacts to marine mammals including Cook Inlet beluga whales. Context would be important (Chinook salmon on the Kuskokwim River), or unique (Cook Inlet beluga whales). **Summary impacts would be minor.**	Barging distance would be reduced by 39%, avoiding the more narrow reaches of the river above Birch Tree Crossing. A longer mine access road (46 miles or 250% longer) would increase displacement of habitat and casual, summertime, subsistence uses. Summary effect would be minor, including reduced barging distance and increased impacts from the longer mine access road. **Summary impacts would be minor.**	Same as Alternative 2.	Same as Alternative 2.
Pipeline	During construction, impact intensity on subsistence hunting would be low, and very low for subsistence fishing. During operations, impact intensity of the buried pipeline would diminish to very low. Increased activity at the Farewell Airstrip would increase competition to medium intensity impacts. Socio-cultural impacts from employment would be the same as for the Mine Site. Duration would be long-term, and extent would be localized to segments of the pipeline. Harvest patterns affected would be generally common in context, except that increased competition in the Farewell Airstrip area would be important in context, based on the incremental increase to competition that already affects harvests by McGrath, Nikolai and Telida. **Summary impacts would be minor, except moderate due to increased competition near Farewell Airstrip area.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-44: Summary of Impacts

Project Component	Alternative 2 - Donlin Gold's Proposed Action	Alternative 3A - LNG-Powered Haul Trucks	Alternative 3B - Diesel Pipeline	Alternative 4 - BTC Port	Alternative 5A - Dry Stack Tailings	Alternative 6A - Dalzell Gorge Route
Section 3.22: Human Health						
All Components	Impacts to human health would be both beneficial and adverse (positive and negative). Benefits to human health would include increased affordability and access to routine and emergency healthcare for acute and chronic conditions, improved food security and increased access to subsistence resources associated with economic benefits generated by the project. Adverse health impacts would be related to potential accidents and injuries, exposure to hazardous constituents, and infectious diseases. Impacts[1] would generally be considered medium in magnitude or intensity, except for accidents and injuries and non-communicable and chronic diseases, where the intensity of the impact could be high. The duration of the impacts would generally be very high, except for infectious diseases and access to routine healthcare services, where the duration of the impact would be high (changes in health indicators would not extend beyond six years and would likely return to baseline levels). The majority of impacts to human health would be medium to high in geographic extent. **Summary impacts would be moderate.**	Health consequences would include reduced rates of accidents and injuries related to water transport, reduced exposures to hazardous constituents in air, water and aquatic biota, and greater access to and quantity of subsistence resources. **Summary impacts would be moderate.**	Health consequences very similar to Alternative 3A. **Summary impacts would be moderate.**	There would be a reduction in the potential for vessel accidents and injuries, an increase in potential surface transport accidents and injuries, a reduction in potential subsistence fisheries impacts, and a potential increase in the displacement of wildlife used by subsistence hunters. **Summary impacts would be moderate.**	Same as Alternative 2.	Same as Alternative 2.
Section 3.23: Transportation						
Mine Site	Nine miles of primitive trails would be affected. Intensity would be low overall as only a few intermittent users would be affected by the removal of trails at the mine site. Duration of effects would be permanent since the trails would not be replaced after mine closure. Effects would be local in extent and limited to the mine site. Trails affected are considered common in context. **Summary impacts would be negligible.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Transportation Facilities	The predominant impact would be from an increase in barge traffic between the Bethel and Angyaruaq (Jungjuk) ports, and an increase in barge receipts at the Port of Bethel. Duration of these medium intensity effects would be long-term and extend throughout the life of the mine. Effects would be regional in extent as communities along the Kuskokwim River from Bethel to the Angyaruaq (Jungjuk) Port would be affected. The context would be important as effects would occur in areas not served by roads that rely extensively on water and air transportation resources. **Summary impacts would be moderate.**	Same as Alternative 2 (reduction in barge trip number).	Intensity would be low due to smaller increase in barge traffic compared to Alternative 2. **Summary impacts would be minor**.	For barge transportation, intensity would be low due to reduced disturbance and displacement of other uses. **Summary impacts would be minor**.	Same as Alternative 2.	Same as Alternative 2.
Pipeline	Intensity would be low overall due to the limited increase in trips and the remote location of the ROW. Duration of effects would be long-term and extend through the life of the pipeline, except for beneficial permanent improvements to existing airstrips. Effects would be regional in extent since effects would occur throughout the proposed project area. The context would be considered important as the communities affected rely on water and air transportation resources and are not served by roads. **Summary impacts would be minor.**	Same as Alternative 2.	Impacts to water transportation in Cook Inlet would be low intensity since the new marine transport would not change or exceed capacity. **Summary impacts would be minor.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Section 3.24: Spill Risk						
All Components	Spill risk is organized by 9 scenarios in Section 3.24 and applied to specific resources. Not every scenario applies to every resource. Please see individual resources for specifics on spill risk (where applicable).	See Alternative 2.	See Alternative 2.	See Alternative 2.	See Alternative 2.	See Alternative 2.

[1] ADHSS (2011, 2015) methodology was used to assess impacts for human health. Impact terminology and ratings differ from other sections in the EIS.

Table 2.3-44: Summary of Impacts

Project Component	Alternative 2 - Donlin Gold's Proposed Action	Alternative 3A - LNG-Powered Haul Trucks	Alternative 3B - Diesel Pipeline	Alternative 4 - BTC Port	Alternative 5A - Dry Stack Tailings	Alternative 6A - Dalzell Gorge Route
Section 3.25: Pipeline Reliability						
Pipeline	Risk to the public is evaluated in Section 3.25 rather than impact effects for the pipeline component. With natural gas pipeline construction, there would be a slight increase in risk to the nearby public. Pipeline location is remote, away from high consequence areas (HCAs), further minimizing risk to the public. No risk factors identified that would support public safety risks higher than current industry experience in terms of anticipated number of severity of incidents.	Same as Alternative 2.	Risks from a natural gas pipeline are eliminated in this alternative, as a natural gas pipeline would not be built.	Same as Alternative 2.	Same as Alternative 2.	The alternative pipeline route would not change public safety risk. Same as Alternative 2.
Section 3.26: Climate Change						
Mine Site	Direct GHG emissions would be generated by a dual-fueled (natural gas and diesel) multi-engine power plant, as well as from mobile machinery and the mining equipment necessary for extraction and processing gold throughout the life of the project. Therefore, impacts would be long-term in duration. All activities and impacts would occur at the mine site; the geographic extent would be local for direct emissions of GHGs. The intensity of direct GHG emissions would be considered medium because impacts would be greater than 1 percent of annual GHG emissions for the State of Alaska, but less than 10 percent of annual GHG emissions for the State of Alaska. Climate change effects on water flow are expected to be of low intensity during the mine life and of low to medium intensity during post-closure; climate effects may or may not be discernable beyond extremes predicted by the historical record, hydrologic designs meet or exceed state guidelines and would be adequate to accommodate climate change effects, and water management and treatment strategies are flexible enough to accommodate potential long-term precipitation trends. Sufficient barge days are predicted under a low-water climate change scenario to meet shipping needs without increased risk of barge stranding. In terms of permafrost, project changes in soil would have a comparably greater effect on permafrost thaw than climate change, as removal or disturbance of soils in most areas of the mine site are expected to accelerate thaw much faster than climate change would on undisturbed soils. Wildlife, TES, fisheries, vegetation, wetlands, and subsistence resource impacts are difficult to quantify with the uncertain nature of climate predictions, but would be related to predicted changes in precipitation and temperature affecting vegetation composition and structure that would in turn impact habitat. **Summary impacts would be minor to moderate.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Transportation Facilities	GHG emissions from fossil fuel combustion would occur from construction equipment, and aircraft, land vehicles and vessels associated with transporting supplies and construction materials to the mine site. GHG emissions associated with operations would result from the combustion of fossil fuels in aircraft, ocean barges, tugs associated with river barges, and tanker trucks delivering diesel. Direct GHG emissions impact would be low (less than 1 percent of Alaska annual GHG emissions). GHG emissions generated by the equipment necessary to conduct closure, reclamation, and post-reclamation activities would last up to 50 years, so impacts would be long-term in duration. Barging could be impacted by changes in precipitation affecting water level. Other resource impacts would similar to those at the mine site. **Summary impacts would be minor.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-44: Summary of Impacts

Project Component	Alternative 2 - Donlin Gold's Proposed Action	Alternative 3A - LNG-Powered Haul Trucks	Alternative 3B - Diesel Pipeline	Alternative 4 - BTC Port	Alternative 5A - Dry Stack Tailings	Alternative 6A - Dalzell Gorge Route
Pipeline	The magnitude of GHG emissions during construction, operations, and closure of all components of this project would be considered low to medium, representing at most 0.024 percent of U.S. total GHG emissions. Precipitation changes could alter stream flow at crossings and scour. Increased precipitation and breakup discharge could cause an increase in the occurrence of glaciation or aufeis effects at co-located ROW and Iditarod National Historic Trail (INHT) segments between MP 84 and MP 97. Other resource impacts would similar to those at the mine site. **Summary impacts would be minor.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

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2.4 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS

The alternative options eliminated from further analysis are presented in tables organized by the major elements of the proposed project:

- 2.4.1 Eliminated Mine Site Options (Table 2.4-1);
- 2.4.2 Eliminated Transportation Options (Table 2.4-2);
- 2.4.3 Eliminated Power Generation Options (Table 2.4-3); and
- 2.4.4 Eliminated Pipeline Options (Table 2.4-4).

The tables provide a short description of each option that was considered and dismissed. Appendix C includes tables that explain why options were considered and provides the rationale for the elimination of each option. All options carried forward are described in Sections 2.3.2 through 2.3.7 above.

Overall, few options were eliminated because they did not meet the screening test for Purpose and Need. The technical and economic feasibility (including logistics in some cases) were evaluated carefully, and these factors were more often the basis for eliminating options. Environmental impacts were assessed at a screening level; some options were eliminated because they would not reduce environmental impacts when compared with the corresponding components of the proposed project. Others were not carried forward as options because they were more properly characterized as potential mitigating measures. Mitigation measures are addressed in Chapter 5, Impact Avoidance, Minimization, and Mitigation.

2.4.1 ELIMINATED MINE SITE OPTIONS

Mine site options eliminated from further analysis are presented in Table 2.4-1.

Table 2.4-1: Mine Site Options Eliminated from Detailed Consideration

Option No.	Option Description
MS-2	Extracting ore by underground mining techniques only (including block caving)
MS-3	Extracting ore by a combination of surface and underground mining techniques
MS-4	Option for altered pit design: flatten pit walls in order to improve stability
MS-5	Grouting the pit-walls and floor to control pit wall/floor infiltration of groundwater
MS-7	Allowing surface-water runoff to enter the pit
MS-9	Using only diesel shovels as loading equipment at the mine site
MS-11	Using a trolley-assist system as hauling equipment at the mine site
MS-12	Using a conveyor system as hauling equipment at the mine site
MS-15	Processing ore by heap leaching. In the heap leaching process, gold is extracted by direct cyanidation of crushed ore placed on a lined pad where the gold-containing solution is percolated through the heap by gravity flow and is collected and further processed to create a final doré product.

Table 2.4-1: Mine Site Options Eliminated from Detailed Consideration

Option No.	Option Description
MS-17	Off-site concentration - transporting flotation concentrate offsite and further processed to recover gold.
MS-20	On-site processing by roasting - oxidizing ground ore in the roasting process, to convert sulfide mineralization to oxides, which are more suitable for carbon-in-leach (CIL) extraction.
MS-21	On-site biological oxidation - using microorganisms to oxidize sulfides in the concentrated ore, allowing gold to be more efficiently removed during the CIL process.
MS-22	Using whole ore instead of concentrate in the pressure oxidation (POX) process
MS-25	Using thiosulfate for chemical extraction -This technology uses calcium thiosulfate (with the addition of ammonia and cupric ion) to extract gold.
MS-26	Using thiourea for chemical extraction `
MS-27	Using bromine for chemical extraction
MS-28	Using a combination of cyanide and other extracting chemicals
MS-29	Locating processing plant on Lower American Ridge
MS-31	Extracting 20,000 tons of ore per day
MS-32	Extracting 30,000 tons of ore per day
MS-34	Extracting 75,000 tons of ore per day
MS-35	Extracting 100,000 tons of ore per day
MS-37	Reducing length, number and vulnerability of process pipelines (design mitigation)
MS-39	Water Treatment: Increasing tank capacity by 50%
MS-40	Water Treatment: Increasing pumping capacity by 50%
MS-41	Water Treatment: Adding backup power supply
MS-42	Zero discharge – Keeping all waste water on site.
MS-43	Treatment and Discharge of Pit Dewatering and Storage/Use/Re-use of Process and Contact Water
MS-44	Treatment and Discharge of all Water
MS-45a	Using alternatives to the Octolig columns for treatment for selenium
MS-50	On-site mercury disposal – building and permitting a small hazardous waste landfill on site for mercury-containing wastes
MS-51	On-site mercury recycling – building a mercury recovery/refining/ recycling facility on-site to recover mercury from mercury-loaded carbon
MS-53	Transporting mercury by air to federally regulated storage facility
MS-54	Using an off-site mercury recycling facility
MS-56	Using Cyanochlor for cyanide neutralization
MS-57	Having on-site segregation and disposal of cyanide-containing waste
MS-58	Tailings Storage: Segregated
MS-60	Neutralizing potentially acid-generating (PAG) waste rock by placing in the TSF.
MS-60a	Neutralizing PAG waste rock by placing in the completed pit.

Table 2.4-1: Mine Site Options Eliminated from Detailed Consideration

Option No.	Option Description
MS-61	Chemical management at the TSF to segregate arsenic-containing tailings for separate handling - In this option the tailings stream would be chemically segregated and the arsenic containing portion would be disposed of separately.
MS-62	Chemical management at the TSF, treating tailings stream with a buffering agent (lime) and/or stabilizing agents (fly-ash, cement)
MS-64	Paste (thickened) tailings
MS-66	Unlined TSF - In this option, only the dam wall of the TSF would be lined.
MS-68	Double-lined TSF
MS-69	High-performance liner
MS-69a	TSF liner design of a prepared surface topped with a layer of clay, overlain by a permeable layer to provide leak detection, topped with a synthetic liner
MS-71	Secondary dam downstream from TSF
MS-72	Designing the TSF with multiple cells in an upstream to downstream sequence
MS-73	Flattening TSF side slopes
MS-74	Improvement of TSF foundation soils
MS-75	Comingling WRF and TSF
MS-75a	Blending PAG 6 into the WRF instead of placing in isolated PAG 6 cells.
MS-75b	Installing a liner under the WRF
MS-75c	Using a high permeability layer underneath the soil layer could also help minimize the amount of water infiltrating the waste rock
MS-78	TSF: Anaconda Creek Valley (single TSF) WRF: American Creek Valley (in WRF), Anaconda Creek Valley (in TSF)
MS-79	TSF: Anaconda Creek Valley (single TSF) WRF: American Creek Valley (2 WRF), Anaconda Creek Valley (in TSF)
MS-80	TSF: Lower American Creek Valley (single TSF) WRF: American Creek Valley (in WRF), ACMA Pit
MS-81	TSF: Upper American Creek Valley (single TSF) WRF: American Creek Valley (in WRF) ACMA Pit
MS-82	TSF: American Creek Valley (CIL/POX tailings), Anaconda Creek Valley (flotation tailings) WRF: American Creek Valley (in WRF) ACMA Pit
MS-83	TSF: Anaconda Creek Valley (CIL/POX tailings cell, and flotation tailings in cell in single TSF) WRF: American Creek Valley (in WRF) ACMA Pit
MS-84	TSF: American Creek Valley (CIL/POX tailings cell, and flotation tailings in cell in single TSF) WRF: American Creek Valley (in WRF)
MS-85	TSF: American Creek Valley (CIL/POX tailings), Anaconda Creek Valley (flotation tailings) WRF: American Creek Valley (in WRF), Anaconda Creek Valley (in TSF)

Table 2.4-1: Mine Site Options Eliminated from Detailed Consideration

Option No.	Option Description
MS-86	TSF: American Creek Valley (years 1-5 production) WRF: American Creek Valley (in WRF), Snow Creek Valley (in TSF)
MS-87	TSF: Snow Creek Valley (single TSF) WRF: American Creek Valley
MS-88	Decommission and remove all mine infrastructure at closure
MS-90	Decommissioning pit with full pit backfill - The pit would be completely backfilled with waste rock, and no pit-lake would form.
MS-92	Decommissioning pit without any backfill - The pit would not be filled with waste rock at all, causing it to fill with water and create a larger pit-lake than Alternative 2.
MS-94	Using wet closure for the TSF
MS-96	Closing TSF by moving all tailings to the pit
MS-97	Self-buffering tailings closure, involving a lime-rich cover layer over the TSF
MS-98	Lined cover cap
MS-100	Using a cover allowing run-on of surface water
MS-102	Using a hard cover with no re-vegetation for the mine site - create a final cover that includes crushed rock to provide erosion protection, with minimal or no re-vegetation
MS-105	Creating a hard closure cover for TSF which does not encourage human or wildlife access
MS-107	Remote-sensing monitoring

Notes:

CIL = carbon-in-leach
MS = mine site
PAG = potentially acid-generating
POX = pressure oxidation
TSF = tailings storage facility
WRF = waste rock facility

2.4.2 ELIMINATED TRANSPORTATION OPTIONS

Transportation options eliminated from further analysis are presented in Table 2.4-2.

Table 2.4-2: Transportation Options Eliminated from Detailed Consideration

Option No.	Option Description
TI-2	Alternative design of the Dutch Harbor cargo & fuel terminals.
TI-4	Bethel Location #2
TI-5	Bethel Location #3
TI-6	Provide a floating port located in Bethel or in the Bering Sea at mouth of the Kuskokwim River.
TI-8	Place the down river port on Fowler Island.

Table 2.4-2: Transportation Options Eliminated from Detailed Consideration

Option No.	Option Description
TI-9	Place the down river port at Johnson Crossing.
TI-10	Place the down river port in Goodnews Bay.
TI-11	Place the down river port at Eek Island.
TI-12	Place the down river port in Security Cove.
TI-13	Place the down river port in Akiachak.
TI-14	Place the down river port in Napakiak.
TI-17	Use air transport for mining equipment and consumables.
TI-19	Air transport of diesel fuel with the Bulk Aviation Transport Tank.
TI-20	Air transport of diesel fuel by a commercial aircraft equipped with fuel storage capabilities.
TI-22	Build a railroad from Bethel to the mine site for cargo and fuel transportation.
TI-23	Build a road from Bethel to the Mine Site
TI-24	Build a road from Dillingham (Nushagak) to the mine site for cargo and fuel transportation.
TI-25	Build a road from Nenana to the mine site for cargo and fuel transportation.
TI-26	Build a road from Cook Inlet to the mine site for cargo and fuel transportation.
TI-27	Roadless year round transport from Dillingham to the mine site for cargo and fuel transportation using Rolligons, an all-purpose, all-terrain, tractor-trailer combination.
TI-28	Roadless year round transport from Nenana to the mine site for cargo and fuel transportation using Rolligons.
TI-29	Roadless year round transport from Cook Inlet to the mine site for cargo and fuel transportation using Rolligons.
TI-30	Build an ice/snow road to the mine site for transportation of cargo and fuel.
TI-31	Establish a winter snow cat route for transportation of cargo and fuel.
TI-32	Use hovercrafts rather than barges for transportation of cargo and fuel to the mine site.
TI-33	Limit barging during key commercial or subsistence fishing periods
TI-34	Build a road to the Yukon River.
TI-35	Build a port on the Yukon River.
TI-36	Tie into the state's planned road to the Yukon River.
TI-37	Build a port at the end of the State planned road to the Yukon River.
TI-38	Upriver barging on the Yukon River.
TI-39	Downriver barging from Nenana (Tanana/ Yukon River).
TI-39a	Establish and maintain a deeper and wider navigation channel between the river mouth and the upriver port
TI-40	Place the upriver port in Aniak. (Aniak Port option)
TI-41	Build a road from the proposed upriver port in Aniak (TI-40) to the mine site.
TI-47	Use riprap for the Angyaruaq (Jungjuk) Port design.
TI-48	Use a removable floating barge & ramp for the Angyaruaq (Jungjuk) port.

Table 2.4-2: Transportation Options Eliminated from Detailed Consideration

Option No.	Option Description
TI-49	Dredge a deeper floating basin at the Angyaruaq (Jungjuk) Port.
TI-51	Use a seasonal/temporary port at Angyaruaq (Jungjuk).
TI-52	Move the pilings landward of the bank at Angyaruaq (Jungjuk) Port.
TI-53	Add a second slip to the Angyaruaq (Jungjuk) Port
TI-55	Use “Hi-Float” or “Chip Seal” on the road to the mine site from Angyaruaq (Jungjuk) Port.
TI-56	Pave the road to the mine site from Angyaruaq (Jungjuk) Port.
TI-56a	Reduce the Angyaruaq (Jungjuk) Port Access road to one lane in wetlands
TI-57b	Reclaim and decommission the road from Angyaruaq (Jungjuk) Port to the mine site at closure
TI-59	Improve the Crooked Creek village airstrip.
TI-60	Build a road between Crooked Creek and the mine site.
TI-62	Reclaim the mine site airstrip after operation was complete.
TI-65	Improve “Kiska Metals” strip for use during pipeline construction
TI-66	Substitute fixed wing planes with helicopters for the construction of the pipeline.
TI-68	Return the gravel used for temporary pipeline construction airstrips to the material sites for full restoration of both airstrip and material sites.

Notes:

TI = transportation infrastructure

2.4.3 ELIMINATED POWER GENERATION OPTIONS

Power generation options eliminated from further consideration are presented in Table 2.4-3.

Table 2.4-3: Power Options Eliminated from Detailed Consideration

Option No.	Option Description
TI-71	Using wind power as the main source of power
TI-72	Using nuclear power as the main source of power
TI-73	Using run-of-the-river hydropower as the main source of power
TI-74	Using conventional hydropower as the main source of power
TI-75	Using biomass as the main power source
TI-76	Using waste-to-fuel as the main power source
TI-77	Using coal as the main power source
TI-78	Using peat power as the main source of power
TI-79	Combining two or more of options TI-69 through TI-78 (energy alternatives)

Table 2.4-3: Power Options Eliminated from Detailed Consideration

Option No.	Option Description
TI-80	Using natural gas-fired electricity generated off-site
TI-81	Purchasing electricity from the existing grid to power the mine site.
TI-82	Purchasing power from Watana Susitna Hydro-electric.
TI-83	Purchasing power generated from the off-site Williamsport Coal Plant
TI-84	Purchasing power generated off-site from a coal plant to be located in Bethel
TI-85	Purchasing power generated off-site from the Beluga Coal Plant
TI-86	Purchasing power generated off-site at the Healy Power Plant (Coal)
TI-87	Building a Bethel LNG Plant with an associated pipeline to the mine site
TI-88	Building a Bethel LNG fuel power facility with a transmission line to the mine site

Notes:
TI = transportation infrastructure

2.4.4 ELIMINATED PIPELINE OPTIONS

Pipeline options eliminated from further analysis are presented in Table 2.4-4.

Table 2.4-4: Pipeline Options Eliminated from Detailed Consideration

Option No.	Option Description
PL-2	Routing an overland natural gas pipeline from Dillingham (Nushagak) to the mine site.
PL-3	Routing an overland natural gas pipeline from Nenana to the mine site.
PL-4	Using alternative routes that do not require substantial grading of hillsides for the pipeline ROW.
PL-6	There was an option to consider pipeline route options near established guide camps to reduce viewshed impacts, e.g., near Windy River.
PL-9	Local route option at Lower Theodore River, MP 0 - MP 5
PL-11	Local route option, Little Mount Susitna East, MP 9 - MP 29
PL-13	Local route option, Theodore River Alternate East, MP 32 - MP 49
PL-15	Local route options along Skwentna River - south, MP 58 – MP 70
PL-16	Regional route option through Alaska Range over Merrill Pass
PL-18	Local route option on south side Alaska Range via North Round Mountain, MP 95 – MP 98
PL-19	Route option through Alaska Range via Goodman Pass west
PL-20	Route option through Alaska Range via Goodman Pass east
PL-21	Route option through Alaska Range via Rainy Pass and Dalzell Gorge, Egypt Mountain, south, MP 141 – MP 150

Table 2.4-4: Pipeline Options Eliminated from Detailed Consideration

Option No.	Option Description
PL-23	Route option through Alaska Range via Rainy Pass and Dalzell Gorge, local route option to avoid salt lick 2-3 miles west of Egypt Mountain, ~MP 146 – MP 147 on Egypt Mountain, north route
PL-25	Route option through Alaska Range via Jones Pass, MPs J 105 – J 150, local route option further to north away from salt lick near Egypt Mountain
PL-26	Regional route option through Alaska Range via Kichatna River Valley; route northwest at Skwentna to Kichatna River then west, bypassing 58 miles co-location with INHT
PL-28	Local route option, St. Johns Hill/Windy Fork north, MP 155 – MP 167
PL-29	Local route option, Big River north, MP 187 – MP 192
PL-30	Moving regional route north along face of Alaska Range, MP 150 – MP 194, to avoid important transitional habitat for wildlife and reduce hunting pressure (from improved access).
PL-32	Local route option, Tatlawiksuk River south, MP 212 – MP 214
PL-34	Local route option, Kuskokwim River south, MP 239 – MP 241
PL-36	Three local route options near Moose Creek
PL-38	Local route option - Kuskokwim Hills south, MP 279 – MP 308 east side E. George River - north, MP 284 – MP 287
PL-39	Local route option - Kuskokwim Hills south, MP 279 – MP 308 east side E. George River - south, MP 284 – MP 287
PL-41	An option that reduces the initial clearing requirements for the majority of the ROW, preferably to less than 50 Feet.
PL-42	Avoiding construction alternatives that require substantial grading of hillsides for the pipeline ROW.
PL-44	An option that does not require clearing of vegetation every 10 years, to preserve early reclamation.
PL-46	Coordinating with PHMSA to refine clearing requirements in consideration with PHMSA's regulations and the ecological values.
PL-47	Installing slope breakers and trench breakers at wetland boundaries to prevent trenches from draining wetlands.
PL-50	Constructing a permanent dirt road or work pad alongside the entire length of pipeline ROW for operations and maintenance.
PL-51	Further restricting public access to the ROW.
PL-52	Facilitating local communities in acquiring a natural gas supply from the pipeline.
PL-54	Reducing the size of the pipeline or possibly even eliminating it.
PL-56	Constructing an above-ground natural gas pipeline.
PL-57a	For Alternative 3B – Diesel Pipeline, construct aboveground.
PL-58	Using the minimum tool concept that is used in wilderness areas (i.e., hand tools or much smaller equipment than usual) for trenching on hillsides.
PL-60	Requiring a dewatering filter bag or geotextile bag when dewatering a trench.
PL-64	Impressed current cathodic protection at large river crossings.
PL-66	Options in event HDD frac-out or scour risk is high (e.g., bridges, aerial, other).

Table 2.4-4: Pipeline Options Eliminated from Detailed Consideration

Option No.	Option Description
PL-67	Option for HDD at all fish-bearing streams.
PL-70	Moving visible pipeline components further from the Kuskokwim shore.
PL-72	Alternative crossing that further avoids Devil's Elbow cemetery.
PL-74	Using freeze depressants for hydro-testing if testing is done in winter or shoulder seasons.
PL-75	Use air testing for pipeline integrity testing.
PL-77	Option for trucking water if water sources inadequate.
PL-79	Alternative placement of valve stations to avoid visual impacts to local businesses, the INHT, hunting/guiding camps and cabins.
PL-80	Placing a valve station close to Rainy Pass Lodge and Kiska Metals.
PL-81	Placing additional valves before/after stream crossings.
PL-83	Increasing the number of remote closure valves.
PL-87	Using a gas-powered compressor station with emissions controls.
PL-88	Providing storage areas to divert pipeline contents in the event of a breakage.
PL-91	Improving pipeline security by burying the pipeline even at fault crossings.
PL-93	Option to time pipe staging to avoid seasonal presence of Beluga whales in critical habitat.
PL-94	An option for housing construction workers in existing lodges.
PL-96	Avoiding wetlands in the positioning of temporary construction camps.
PL-99	Minimizing the use of culverts and associated fill in flowing waterways.
PL-102	Constructing temporary access roads using geotextile, "Chip Seal," "High Float," or paving.
PL-105	Enacting seasonal timing restrictions on blasting.
PL-106	Reduce the total number of material sites by maximizing the distance between them.
PL-109	Constructing a gas pipeline laid on the ground and not buried.
PL-110	Constructing a diesel pipeline parallel to the natural gas pipeline.

Abbreviations:

HDD = horizontal directional drilling
PL = pipeline
MP = milepost
ROW = right-of-way

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